

SUPPLEMENTARY DATA

## **Corrosion resistance studies of carbon-encapsulated iron nanoparticles**

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## Analyses for carbon-encapsulated iron nanoparticles

Powder X-ray diffractograms and magnetic hysteresis loops  
for raw and purified carbon-encapsulated iron nanoparticles

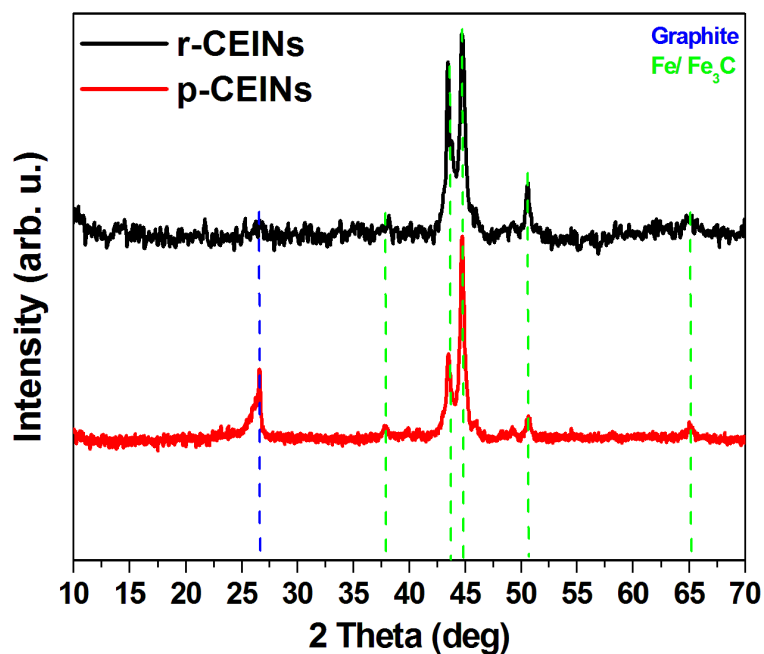


Figure S1. Powder X-ray diffractograms for raw and purified carbon-encapsulated iron nanoparticles.

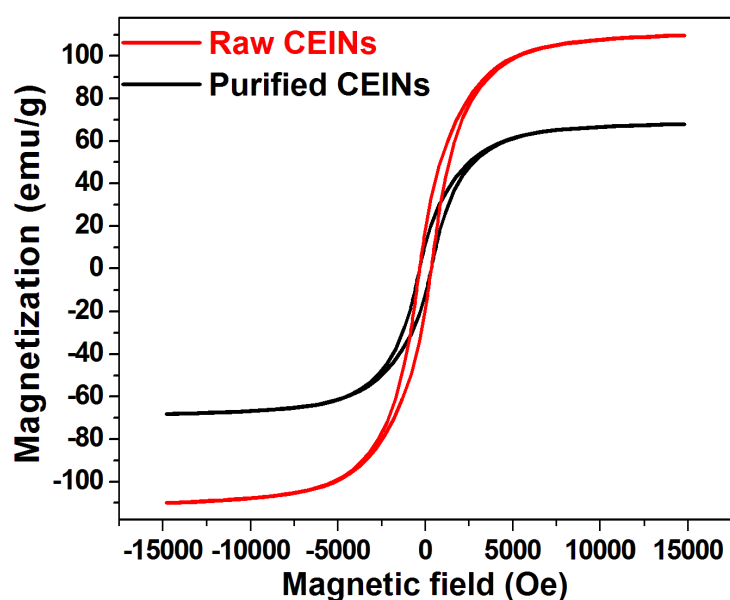


Figure S2. Magnetic hysteresis curves for raw and purified carbon-encapsulated iron nanoparticles.

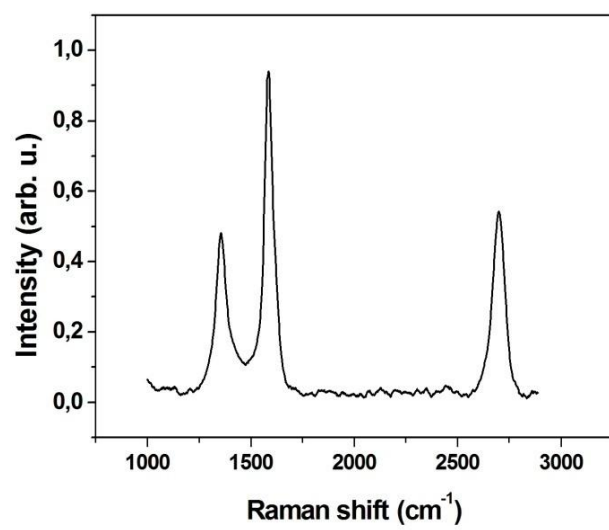


Figure S3. Raman spectrum for purified CEINs.

# Analyses for carbon-encapsulated iron nanoparticles treated with mineral and organic acids

## Thermogravimetric curves

(corrosion agent and corrosion conditions are listed below each curve)

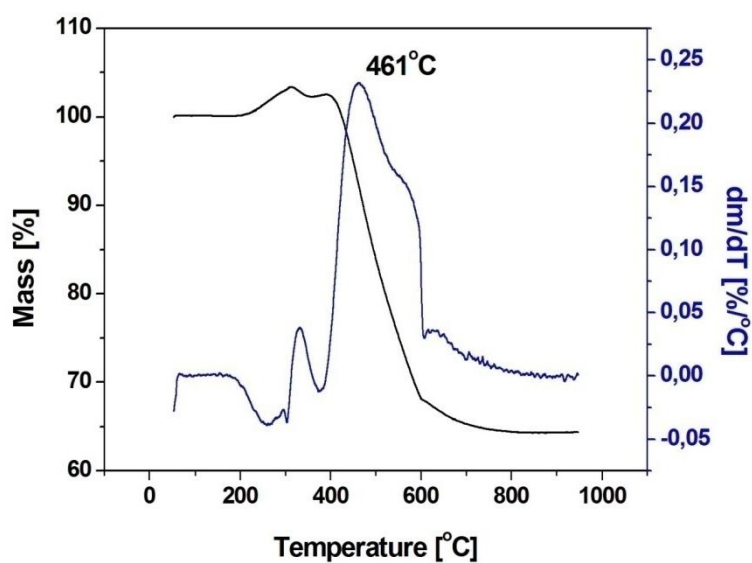


Figure S4. Thermogravimetric curve for CEINs treated with 1M KNO<sub>3</sub> at boiling point.

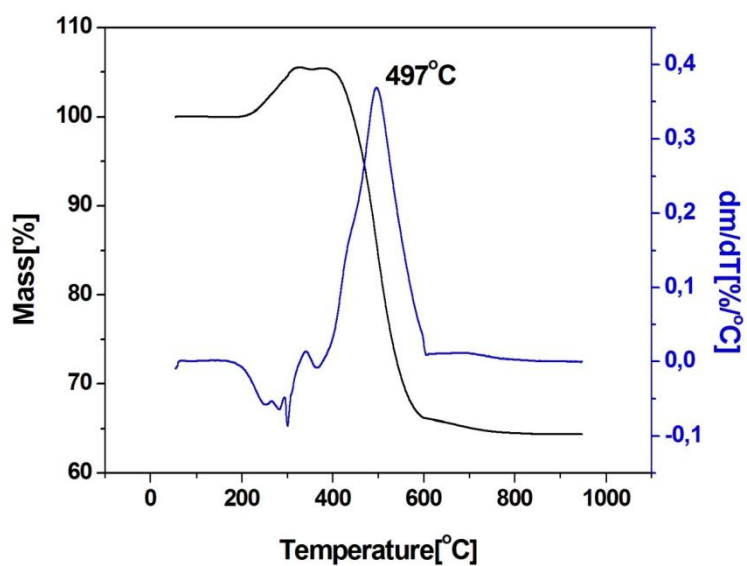


Figure S5. Thermogravimetric curve for CEINs treated with 1M HCl at boiling point.

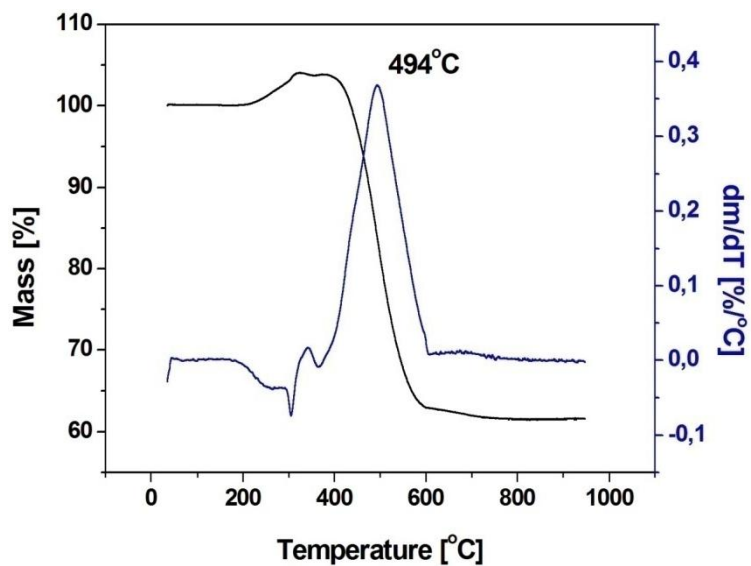


Figure S6. Thermogravimetric curve for CEINs treated with 5M HCl at boiling point.

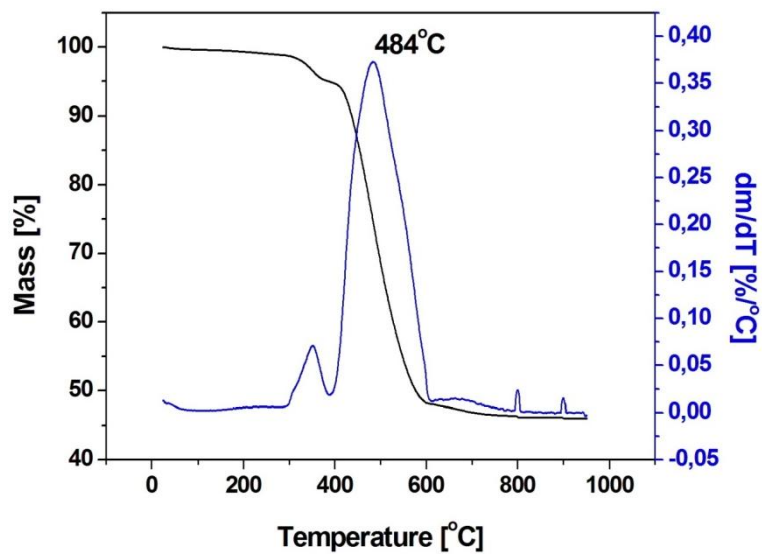


Figure S7. Thermogravimetric curve for CEINs treated with 1M HNO<sub>3</sub> at boiling point.

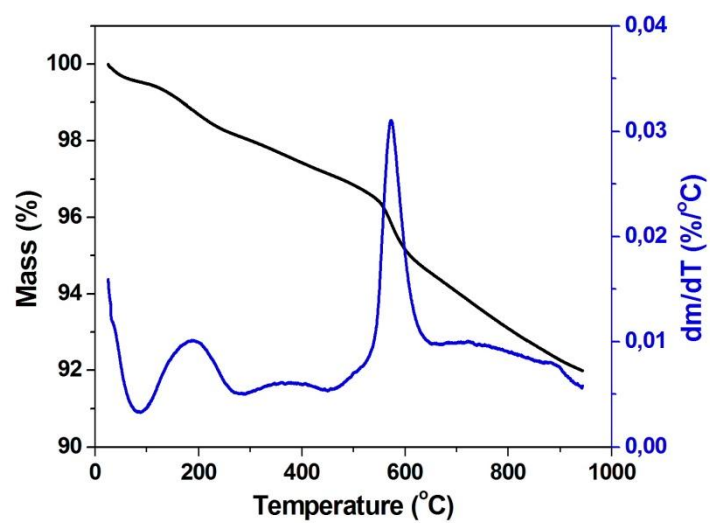


Figure S8. Thermogravimetric curve for CEINs treated with 1M HNO<sub>3</sub> at boiling point (TGA under nitrogen).

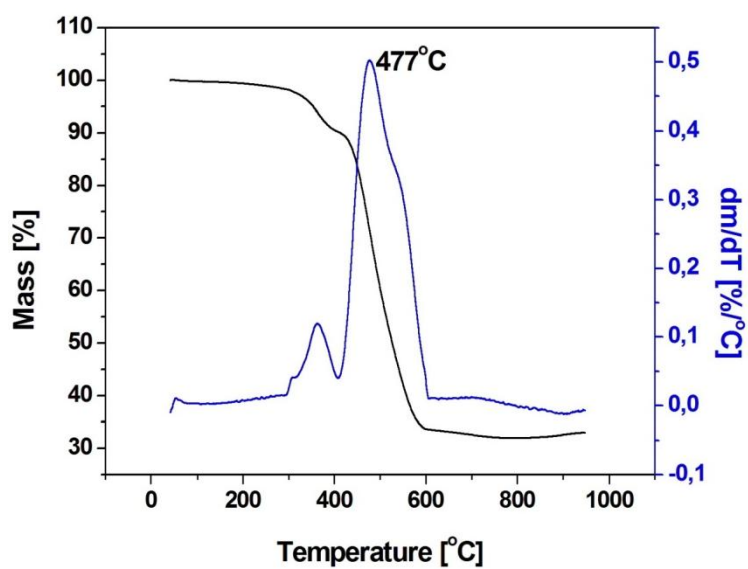


Figure S9. Thermogravimetric curve for CEINs treated with 5M HNO<sub>3</sub> at boiling point.

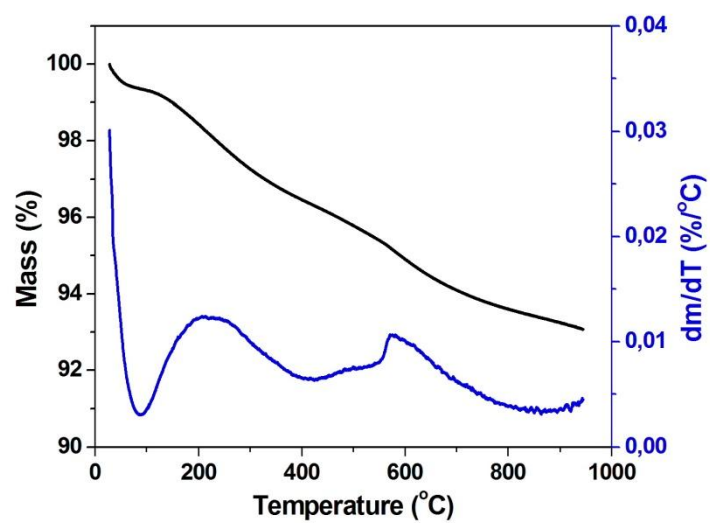


Figure S10. Thermogravimetric curve for CEINs treated with 5M HNO<sub>3</sub> at boiling point (TGA under nitrogen).

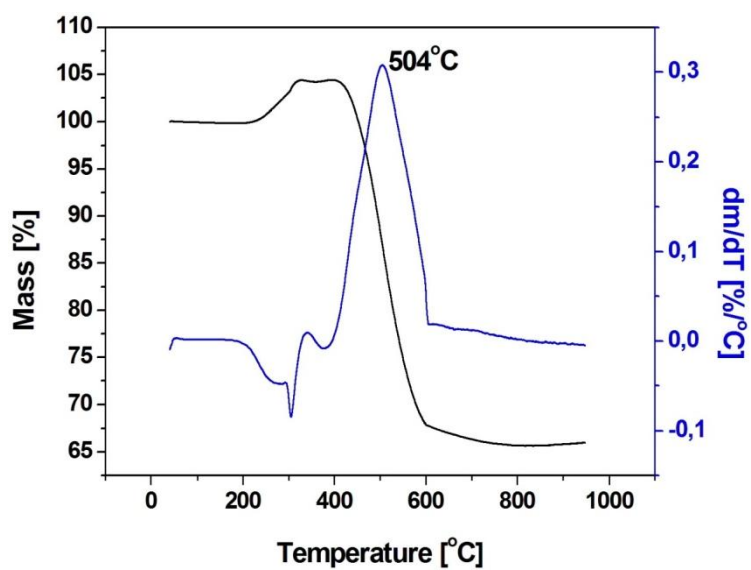


Figure S11. Thermogravimetric curve for CEINs treated with 1M H<sub>2</sub>SO<sub>4</sub> at boiling point.

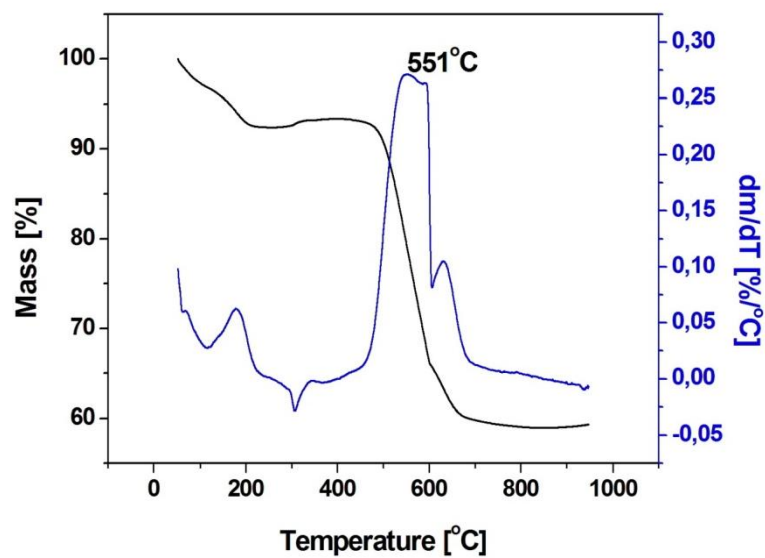


Figure S12. Thermogravimetric curve for CEINs treated with 5M H<sub>2</sub>SO<sub>4</sub> at boiling point.

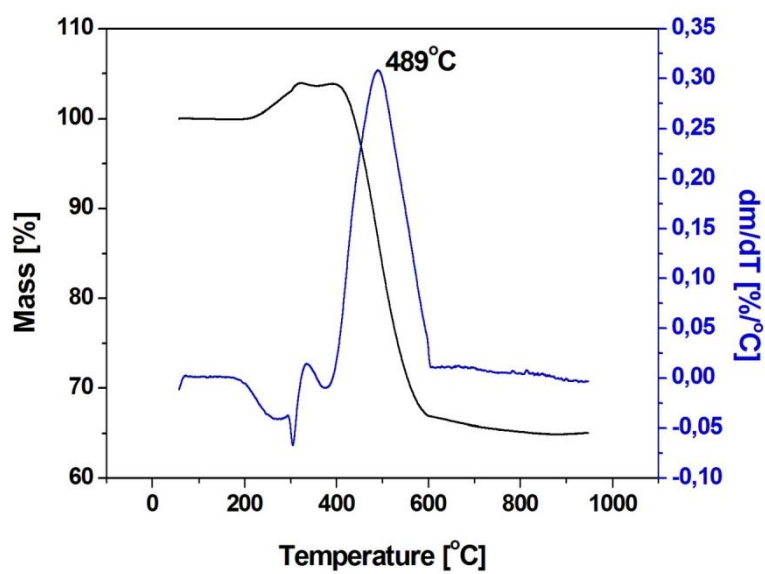


Figure S13. Thermogravimetric curve for CEINs treated with 1M CH<sub>3</sub>COOH at boiling point.



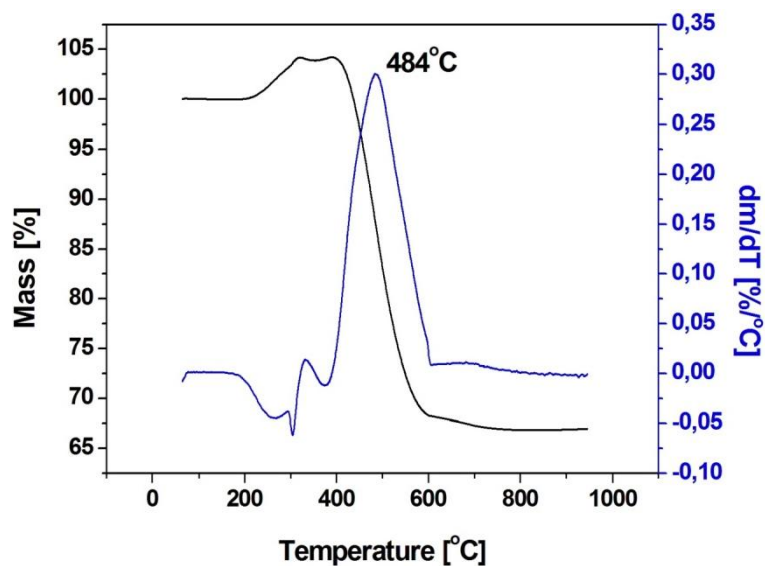


Figure S14. Thermogravimetric curve for CEINs treated with 5M  $\text{CH}_3\text{COOH}$  at boiling point.

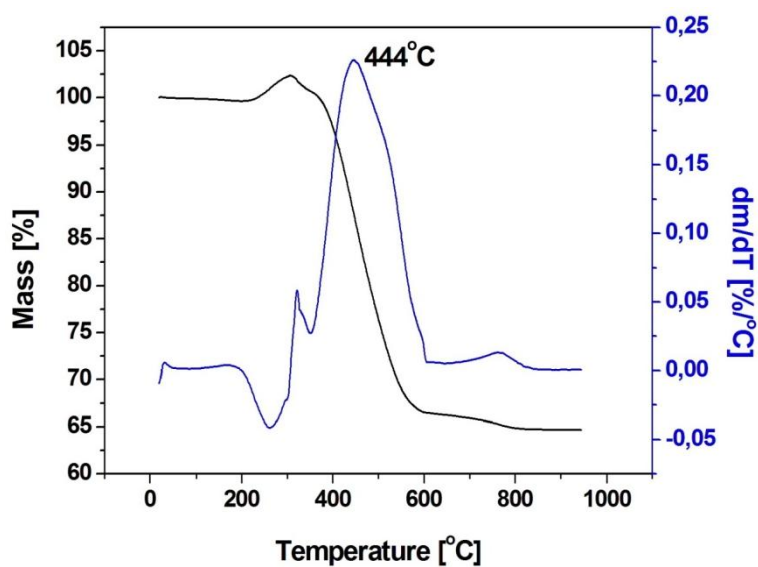


Figure S15. Thermogravimetric curve for CEINs treated with 1M  $\text{KNO}_3$  at room temperature.

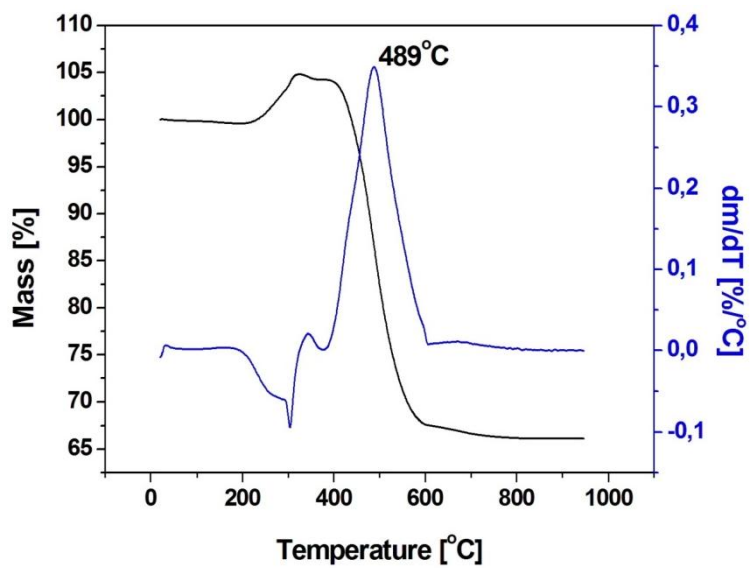


Figure S16. Thermogravimetric curve for CEINs treated with 1M HCl at room temperature.

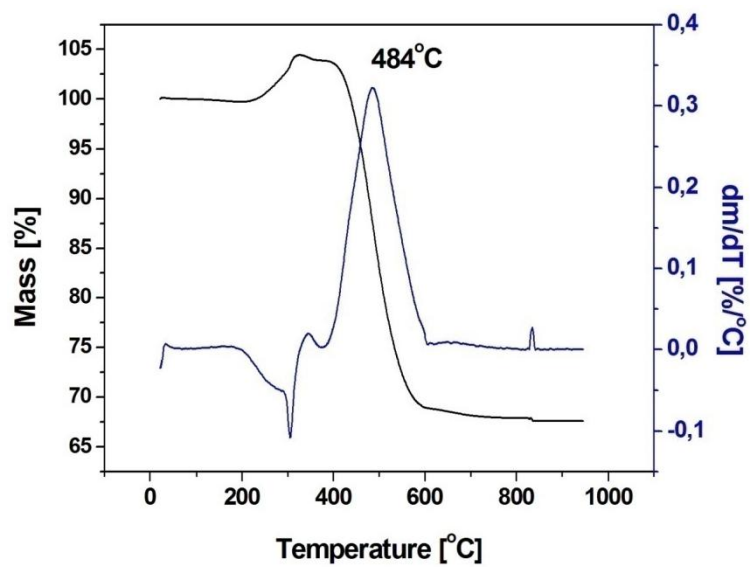


Figure S17. Thermogravimetric curve for CEINs treated with 5M HCl at room temperature.

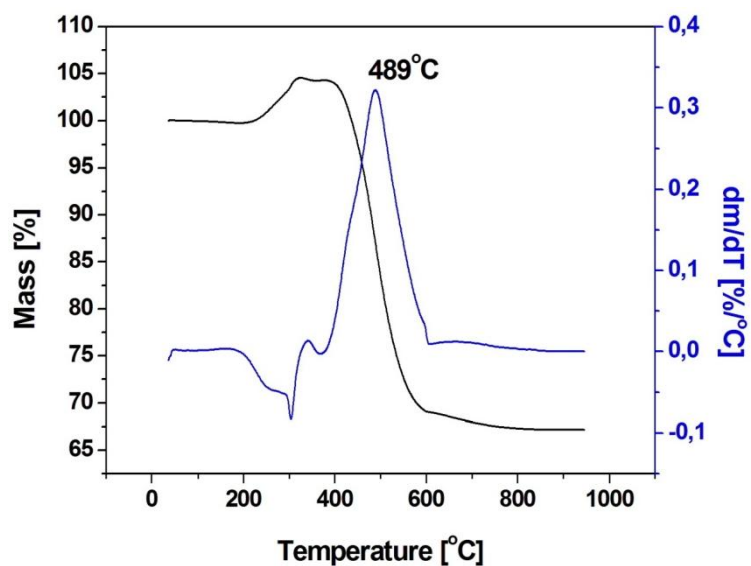


Figure S18. Thermogravimetric curve for CEINs treated with 1M HNO<sub>3</sub> at room temperature.

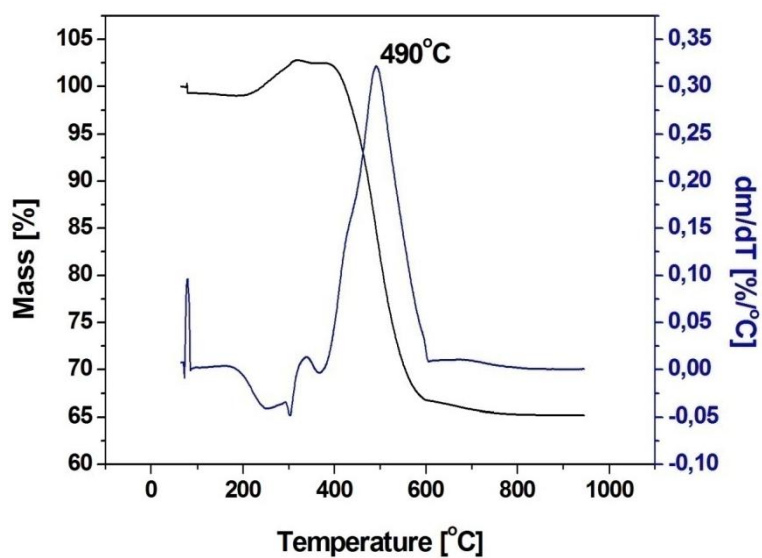


Figure S19. Thermogravimetric curve for CEINs treated with 5M HNO<sub>3</sub> at room temperature.

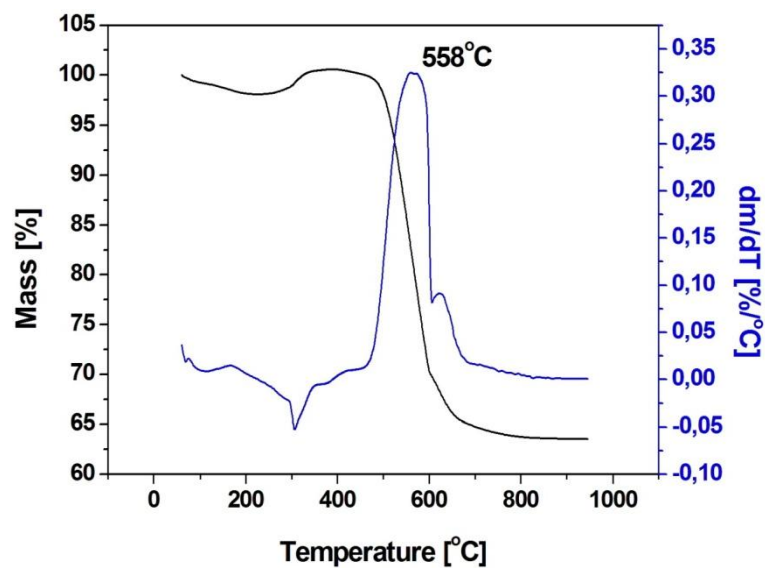


Figure S20. Thermogravimetric curve for CEINs treated with 1M H<sub>2</sub>SO<sub>4</sub> at room temperature.

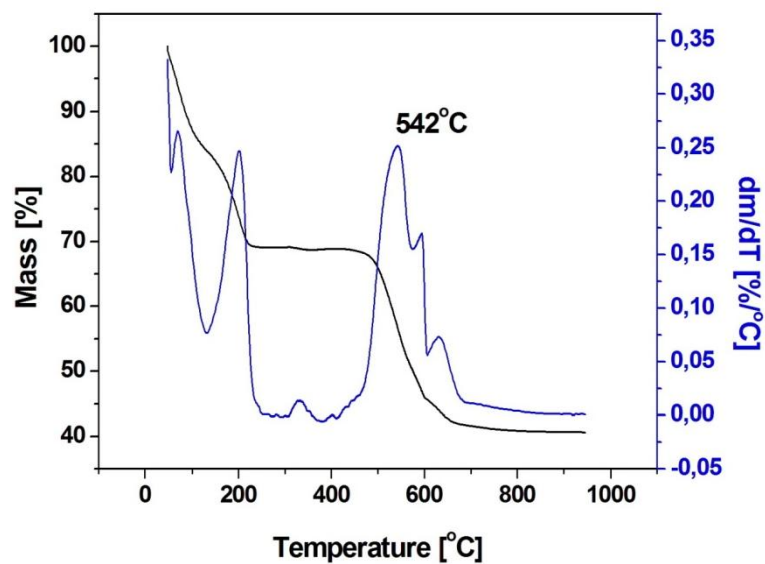


Figure S21. Thermogravimetric curve for CEINs treated with 5M H<sub>2</sub>SO<sub>4</sub> at room temperature.

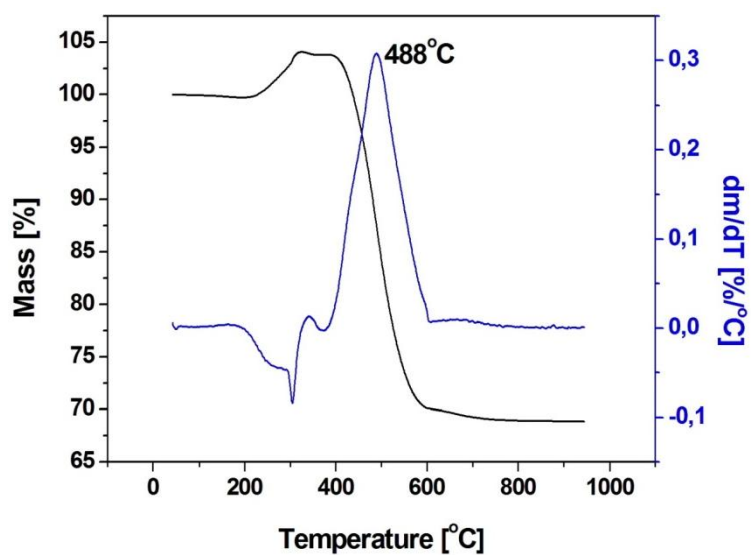


Figure S22. Thermogravimetric curve for CEINs treated with 1M CH<sub>3</sub>COOH at room temperature.

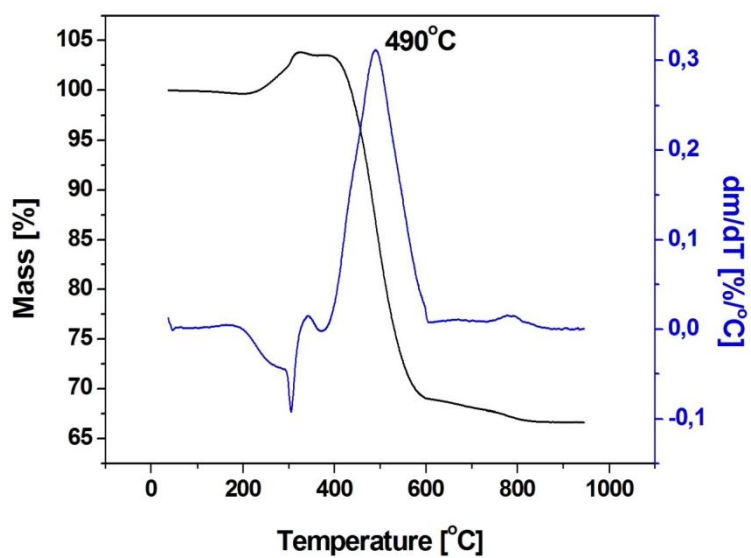


Figure S23. Thermogravimetric curve for CEINs treated with 5M CH<sub>3</sub>COOH at room temperature.



## Raman spectra

(corrosion agent and corrosion conditions are listed below each spectrum)

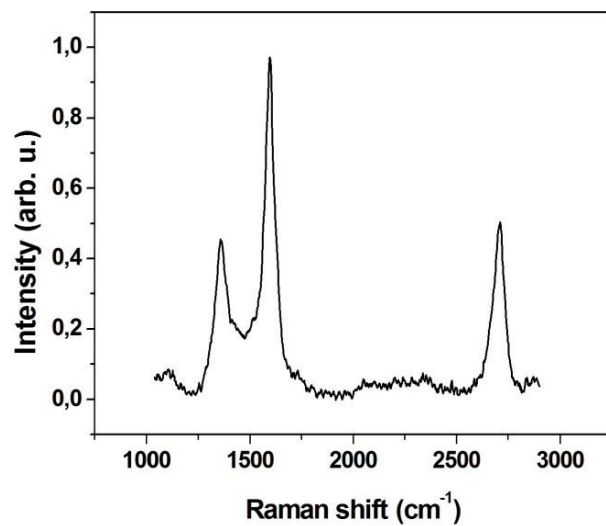


Figure S24. Raman spectrum for CEINs treated with 1M KNO<sub>3</sub> at boiling point.

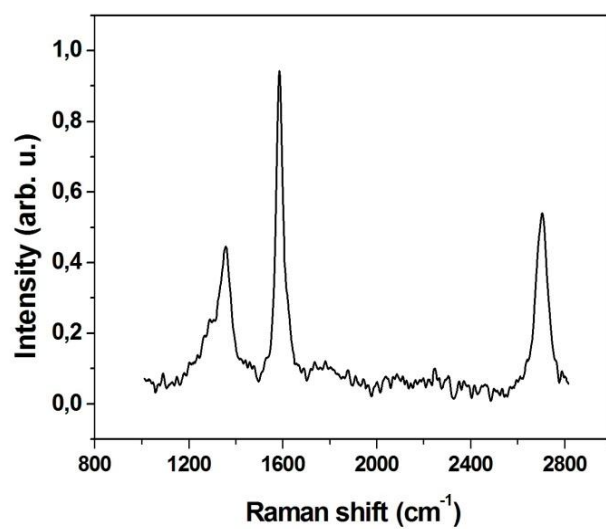


Figure S25. Raman spectrum for CEINs treated with 1M HCl at boiling point.

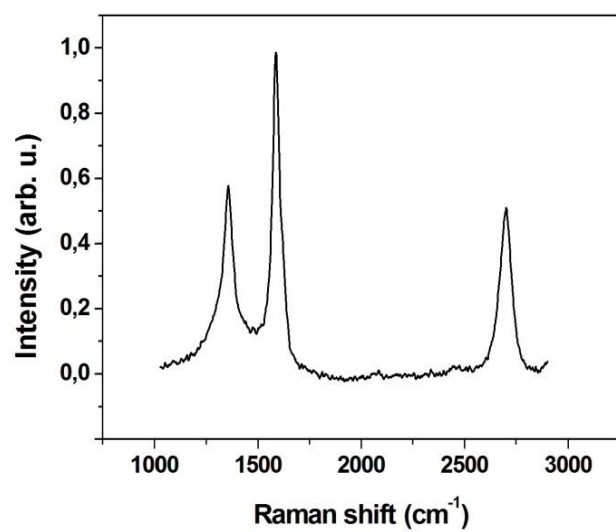


Figure S26. Raman spectrum for CEINs treated with 5M HCl at boiling point.

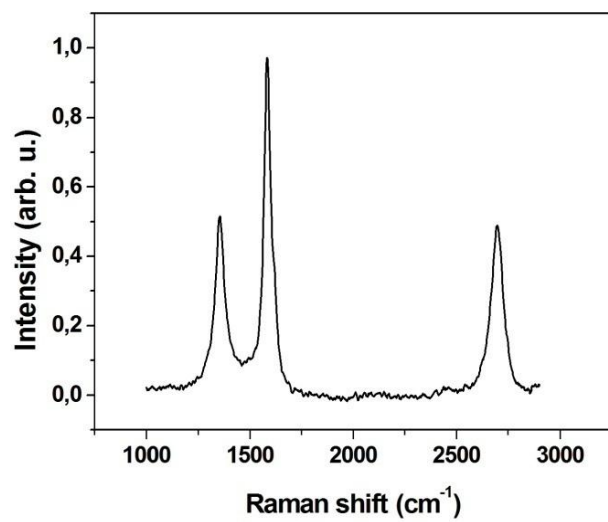


Figure S27. Raman spectrum for CEINs treated with 1M HNO<sub>3</sub> at boiling point.



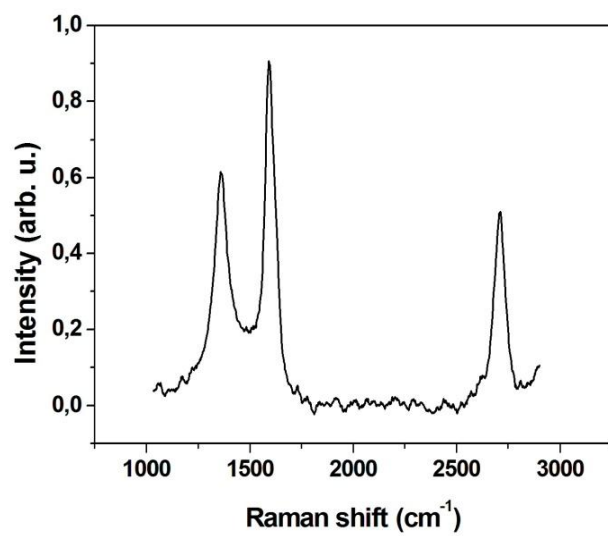


Figure S28. Raman spectrum for CEINs treated with 5M HNO<sub>3</sub> at boiling point.

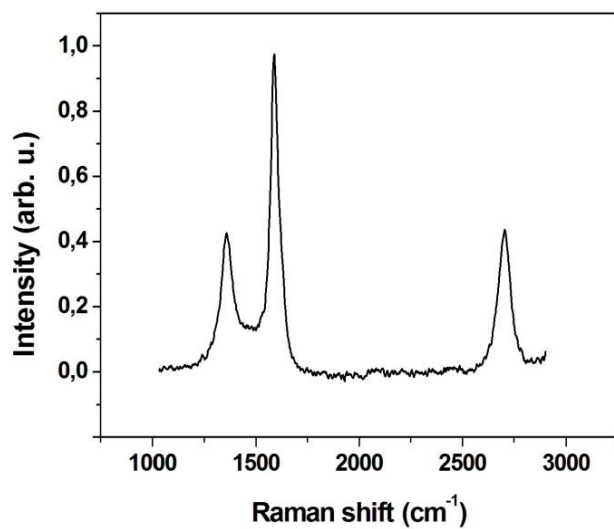


Figure S29. Raman spectrum for CEINs treated with 1M H<sub>2</sub>SO<sub>4</sub> at boiling point.

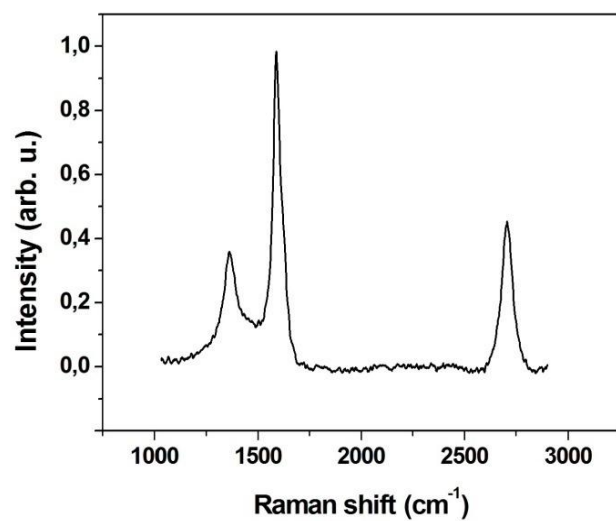


Figure S30. Raman spectrum for CEINs treated with 5M H<sub>2</sub>SO<sub>4</sub> at boiling point.

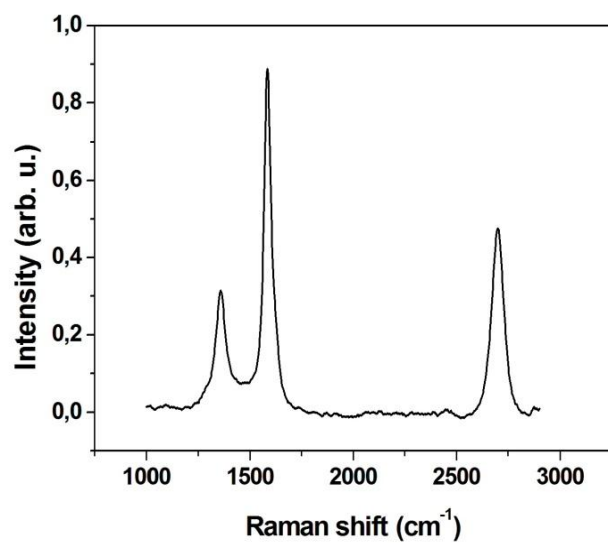


Figure S31. Raman spectrum for CEINs treated with 1M CH<sub>3</sub>COOH at boiling point.

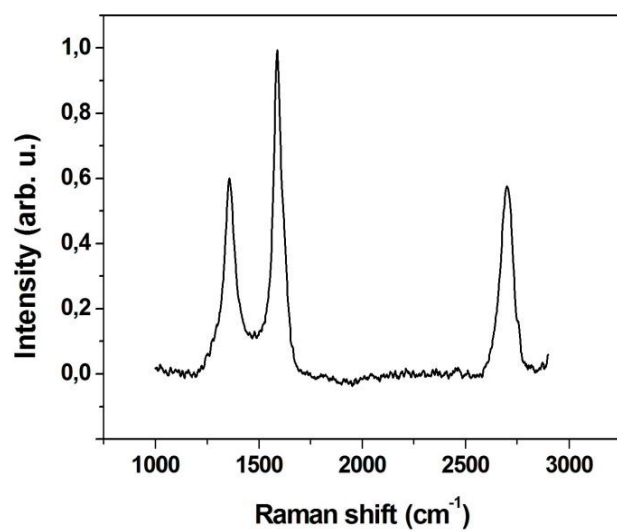


Figure S32. Raman spectrum for CEINs treated with 5M CH<sub>3</sub>COOH at boiling point.

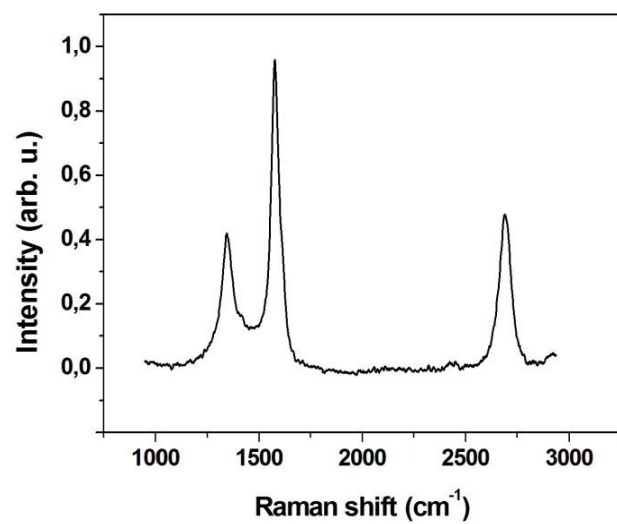


Figure S33. Raman spectrum for CEINs treated with 1M KNO<sub>3</sub> at room temperature.

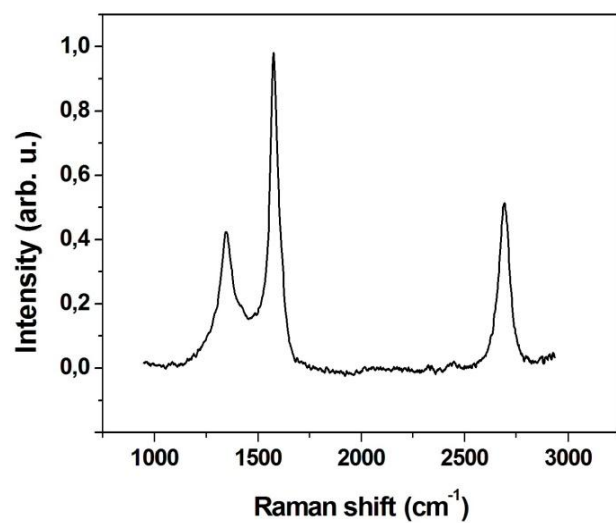


Figure S34. Raman spectrum for CEINs treated with 1M HCl at room temperature.

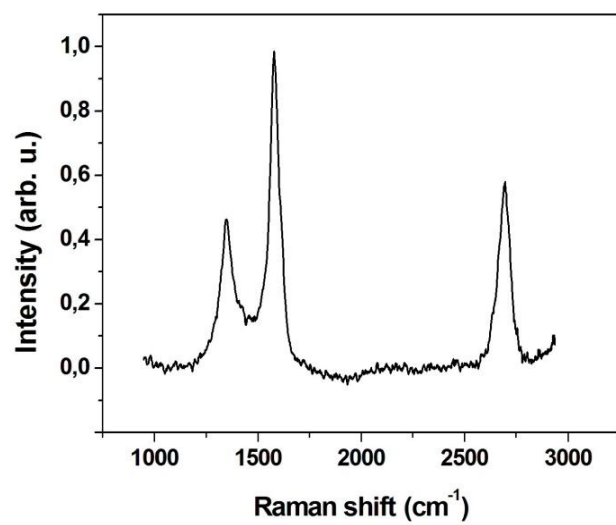


Figure S35. Raman spectrum for CEINs treated with 5M HCl at room temperature.

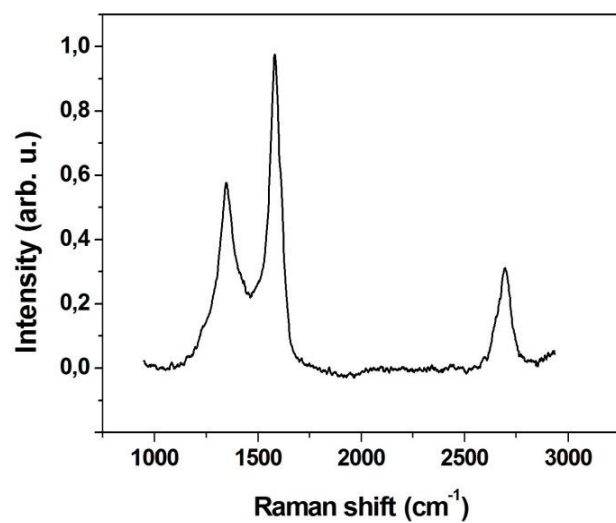


Figure S36. Raman spectrum for CEINs treated with 1M HNO<sub>3</sub> at room temperature.

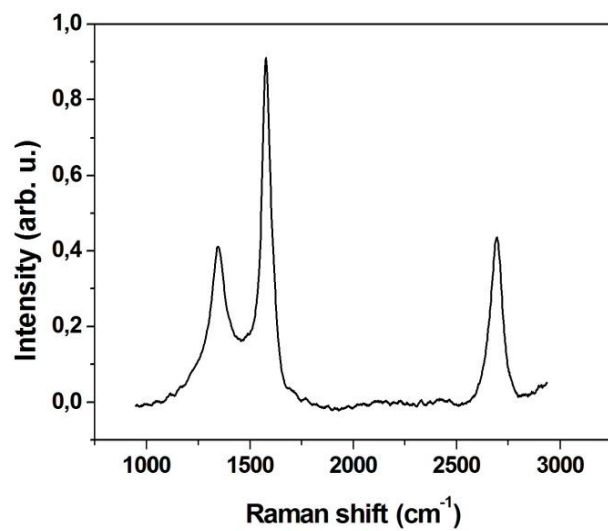


Figure S37. Raman spectrum for CEINs treated with 5M HNO<sub>3</sub> at room temperature.

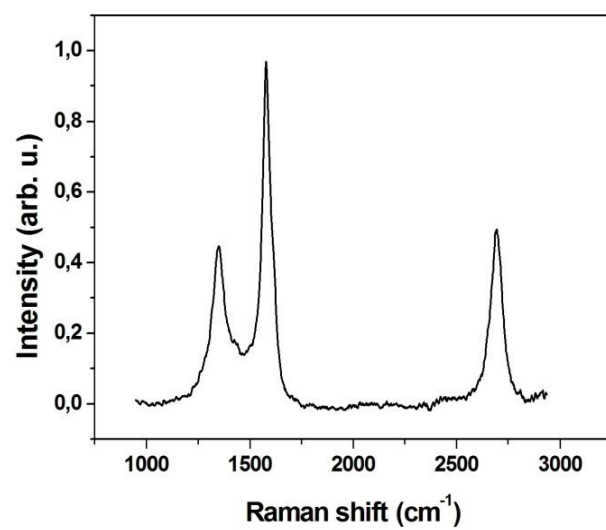


Figure S38. Raman spectrum for CEINs treated with 1M H<sub>2</sub>SO<sub>4</sub> at room temperature.

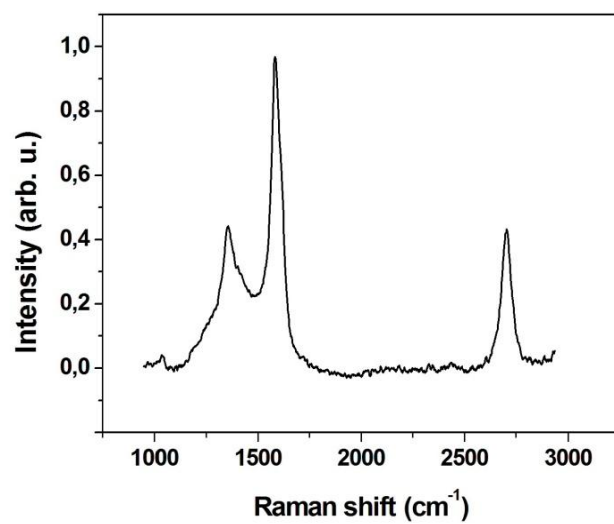


Figure S39. Raman spectrum for CEINs treated with 5M H<sub>2</sub>SO<sub>4</sub> at room temperature.

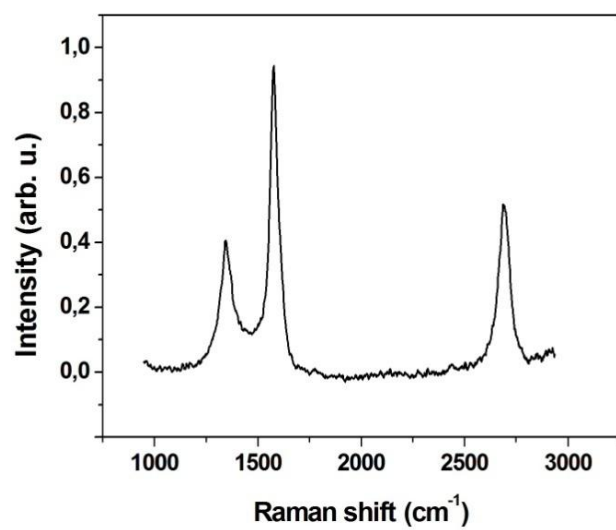


Figure S40. Raman spectrum for CEINs treated with 1M CH<sub>3</sub>COOH at room temperature.

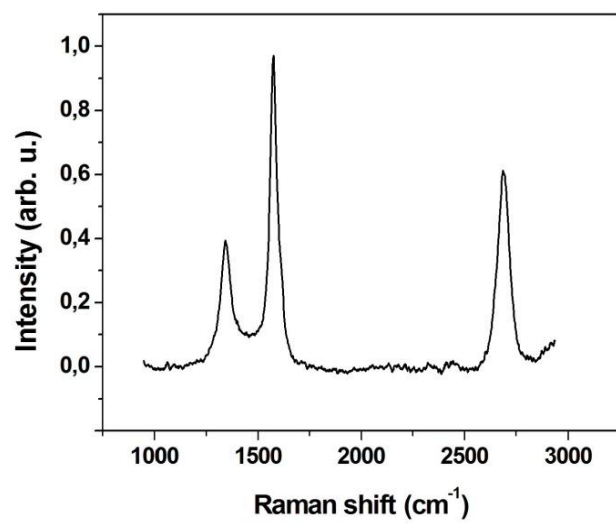


Figure S41. Raman spectrum for CEINs treated with 5M CH<sub>3</sub>COOH at room temperature.

### Magnetic hysteresis loops

(corrosion agent and corrosion conditions are listed below each curve)

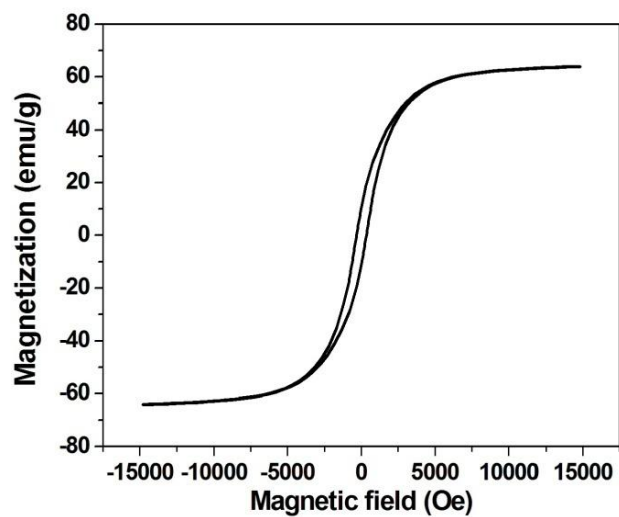


Figure S42. Magnetic hysteresis loop for CEINs treated with 1M KNO<sub>3</sub> at boiling point.

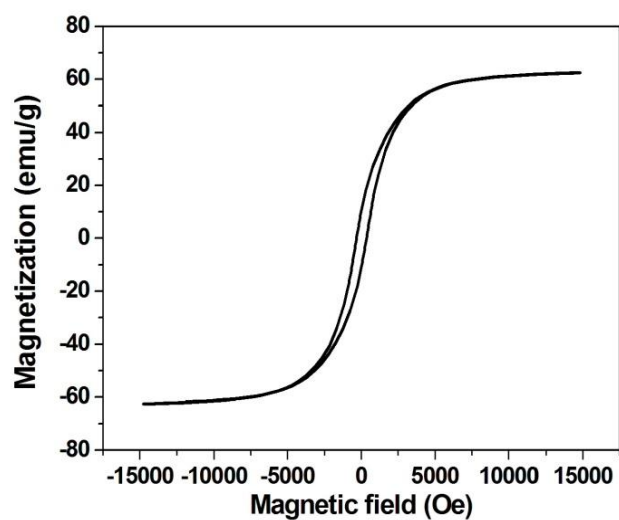


Figure S43. Magnetic hysteresis loop for CEINs treated with 1M HCl at point.



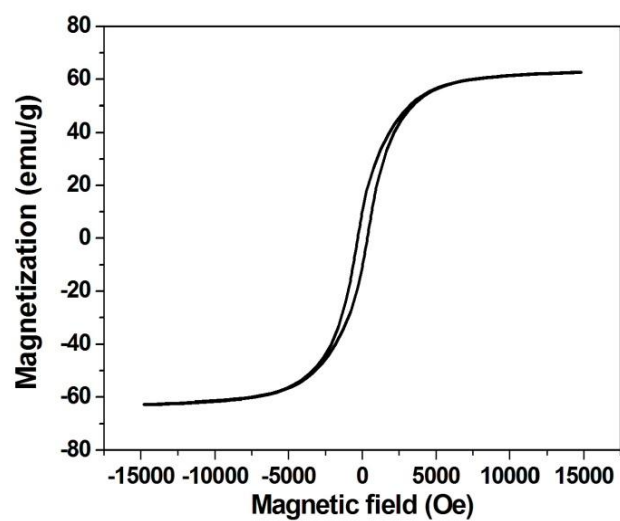


Figure S44. Magnetic hysteresis loop for CEINs treated with 5M HCl at boiling point.

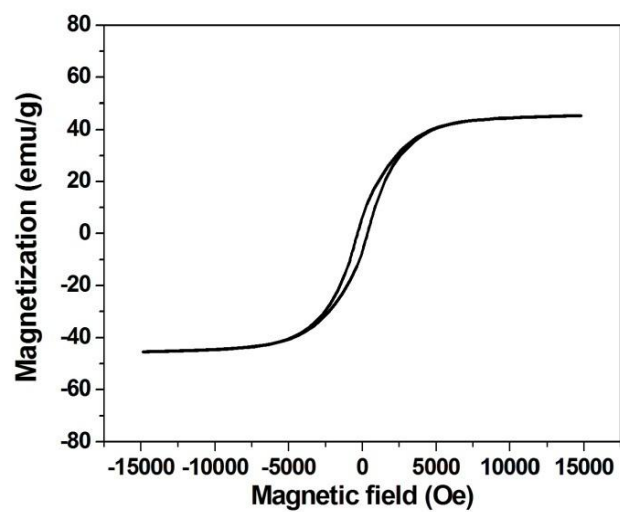


Figure S45. Magnetic hysteresis loop for CEINs treated with 1M HNO<sub>3</sub> at boiling point.

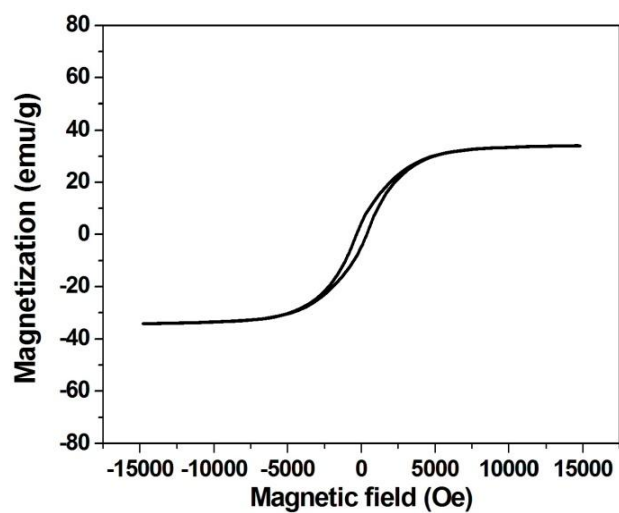


Figure S46. Magnetic hysteresis loop for CEINs treated with 5M HNO<sub>3</sub> at boiling point.

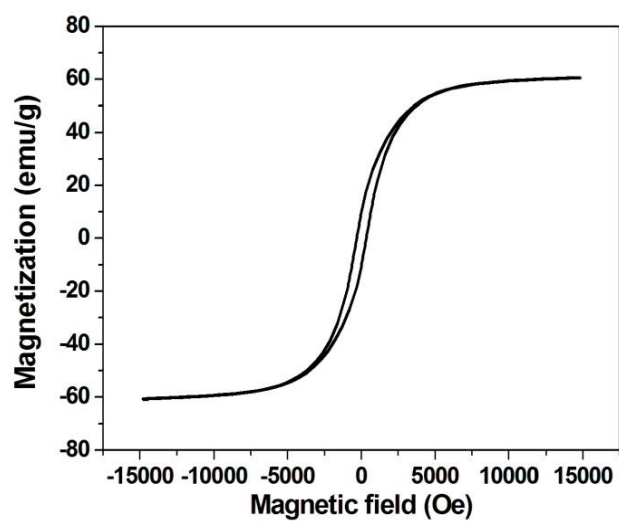


Figure S47. Magnetic hysteresis loop for CEINs treated with 1M H<sub>2</sub>SO<sub>4</sub> at boiling point.

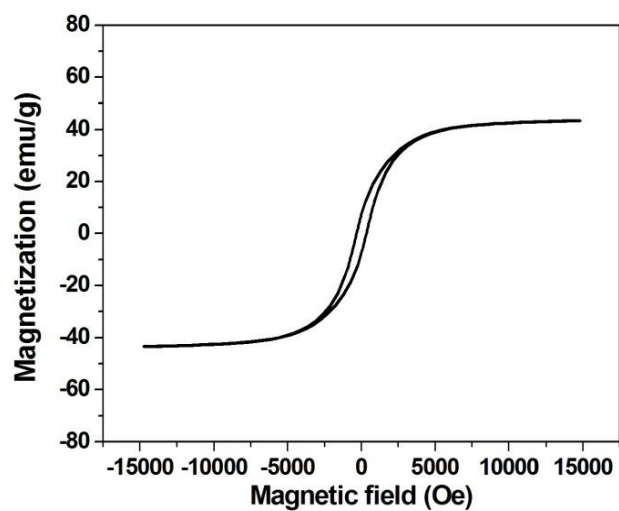


Figure S48. Magnetic hysteresis loop for CEINs treated with 5M H<sub>2</sub>SO<sub>4</sub> at boiling point.

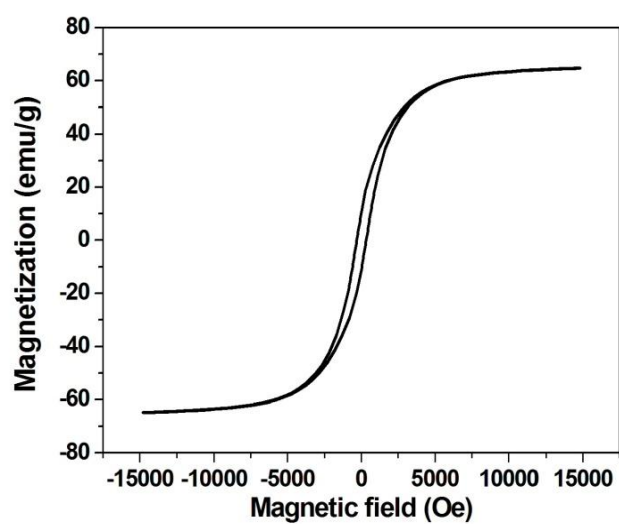


Figure S49. Magnetic hysteresis loop for CEINs treated with 1M CH<sub>3</sub>COOH at boiling point.

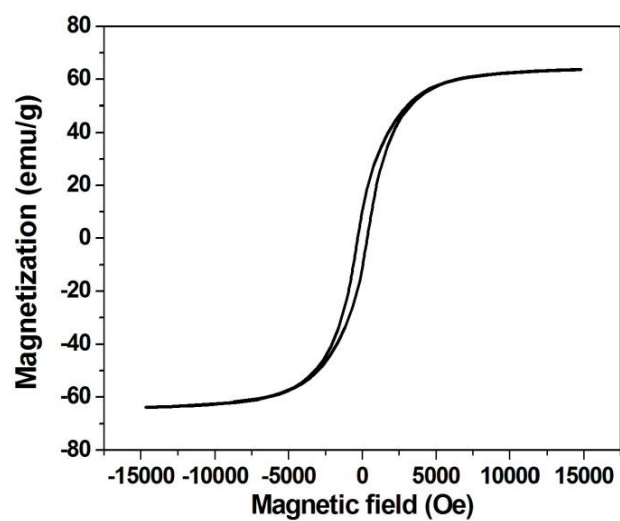


Figure S50. Magnetic hysteresis loop for CEINs treated with 5M CH<sub>3</sub>COOH at boiling point.

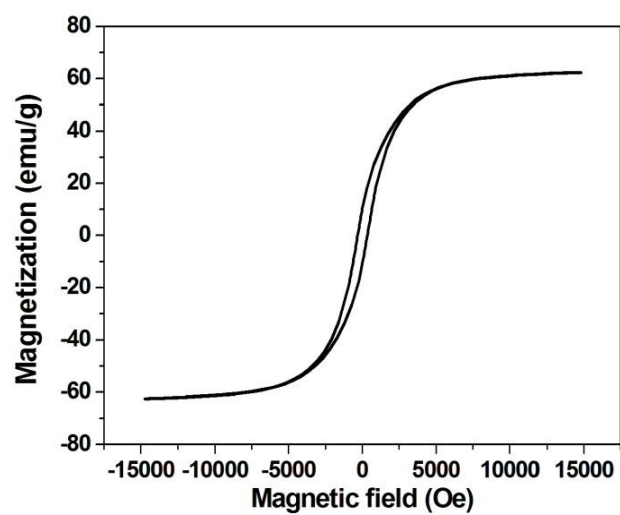


Figure S51. Magnetic hysteresis loop for CEINs treated with 1M KNO<sub>3</sub> at room temperature.

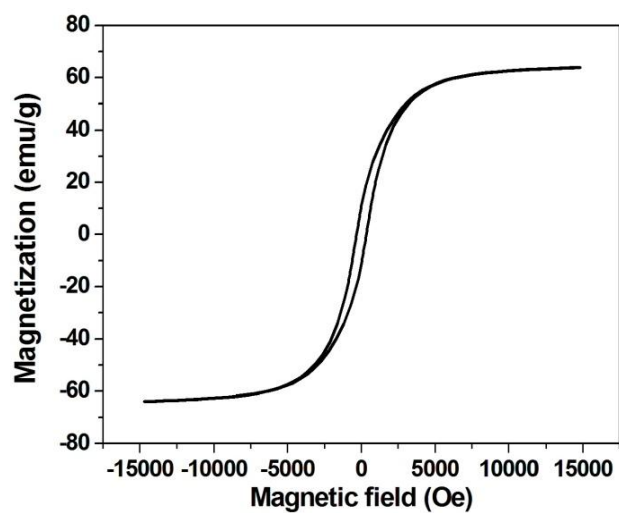


Figure S52. Magnetic hysteresis loop for CEINs treated with 1M HCl at room temperature.

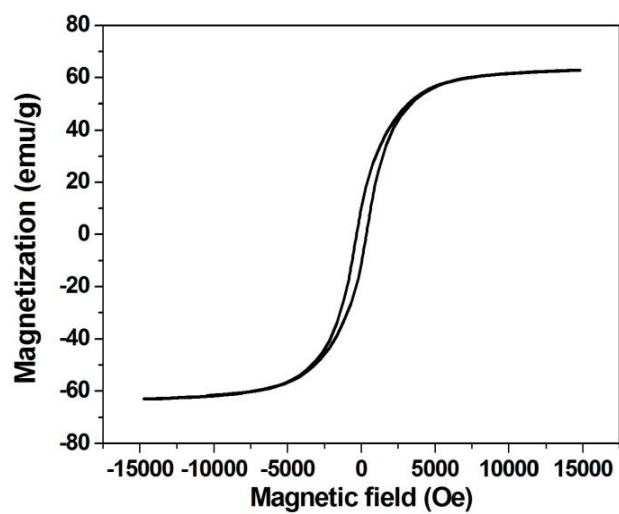


Figure S53. Magnetic hysteresis loop for CEINs treated with 5M HCl at room temperature.

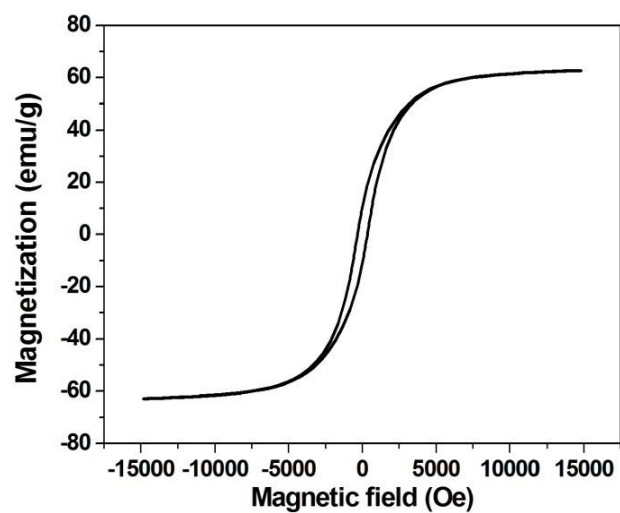


Figure S54. Magnetic hysteresis loop for CEINs treated with 1M HNO<sub>3</sub> at room temperature.

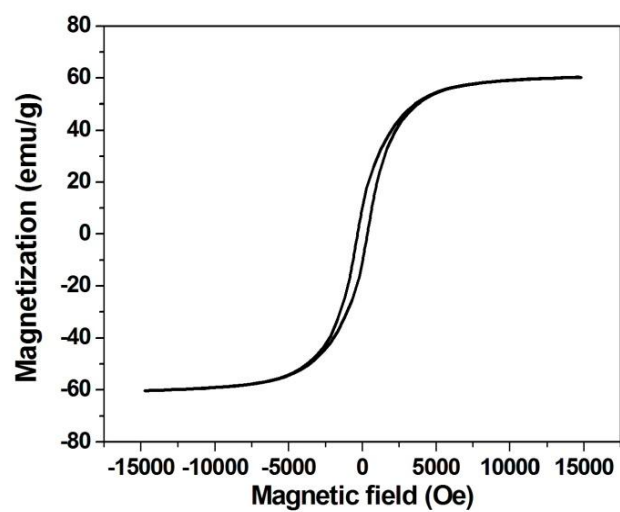


Figure S55. Magnetic hysteresis loop for CEINs treated with 5M HNO<sub>3</sub> room temperature.

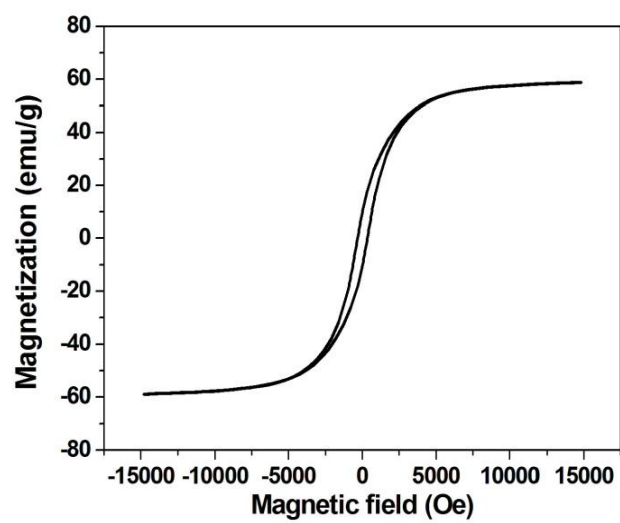


Figure S56. Magnetic hysteresis loop for CEINs treated with 1M H<sub>2</sub>SO<sub>4</sub> at room temperature.

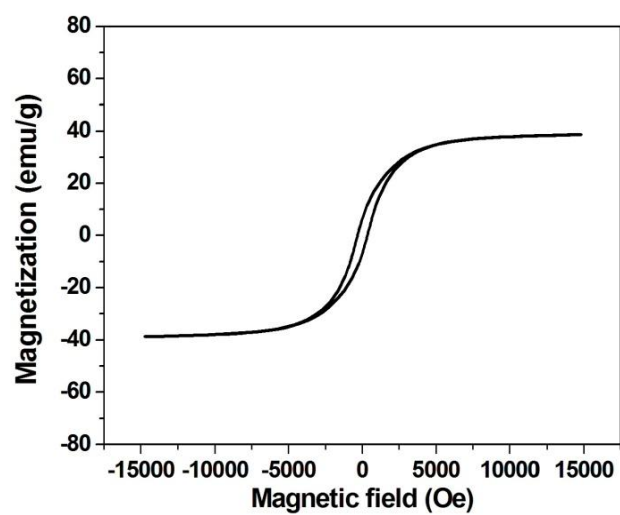


Figure S57. Magnetic hysteresis loop for CEINs treated with 5M H<sub>2</sub>SO<sub>4</sub> at room temperature.

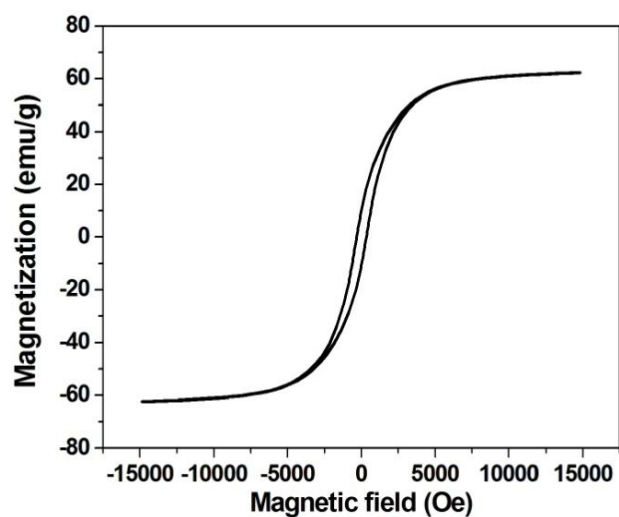


Figure S58. Magnetic hysteresis loop for CEINs treated with 1M CH<sub>3</sub>COOH at room temperature.

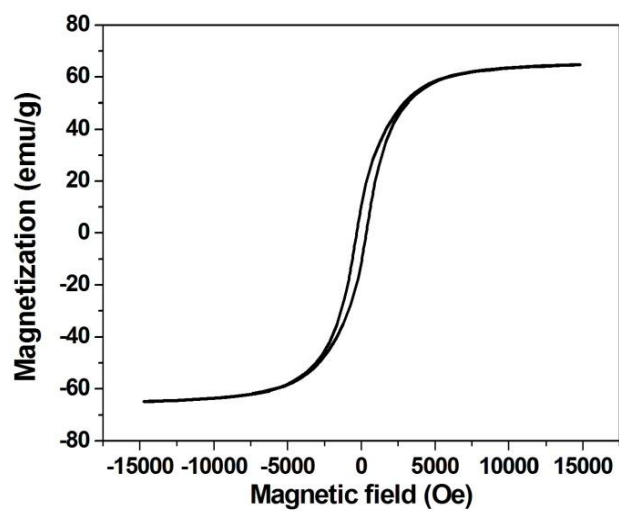


Figure S59. Magnetic hysteresis loop for CEINs treated with 5M CH<sub>3</sub>COOH at room temperature.



## Analyses for carbon-encapsulated iron nanoparticles treated with galvanic corrosion

### Thermogravimetric curves

(corrosion agent and corrosion conditions are listed below each curve)

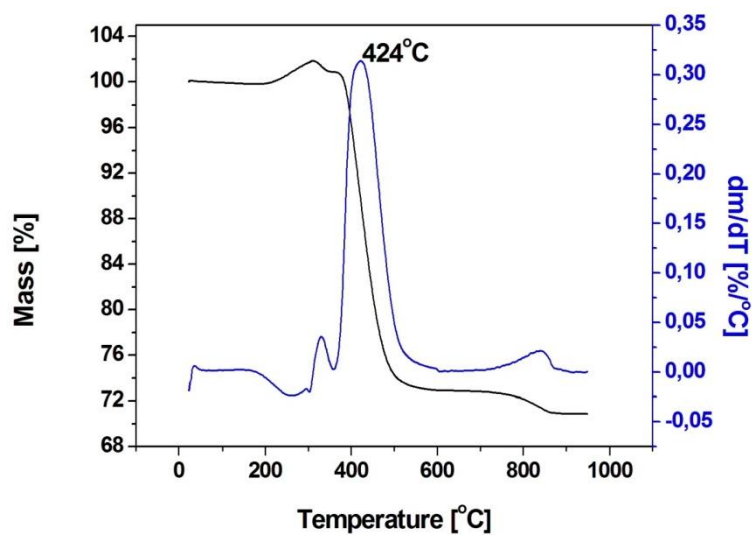


Figure S60. Thermogravimetric curve for CEINs treated with 1M AgNO<sub>3</sub> at boiling point.

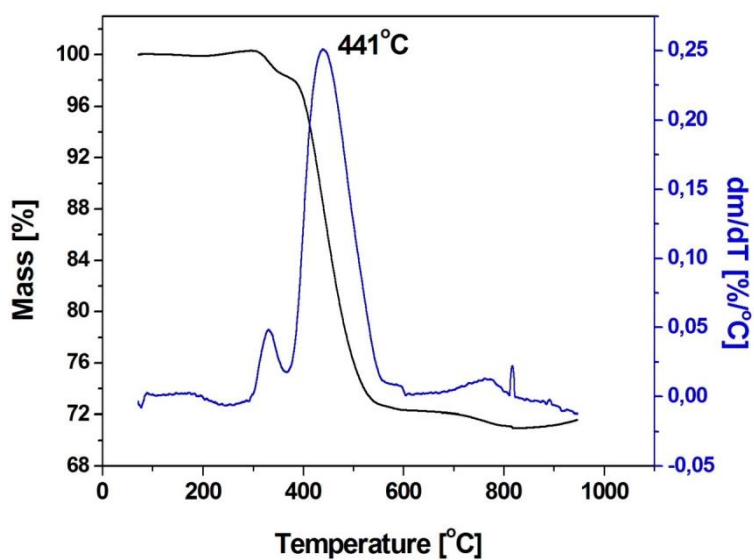


Figure S61. Thermogravimetric curve for CEINs treated with 5M AgNO<sub>3</sub> at boiling point.

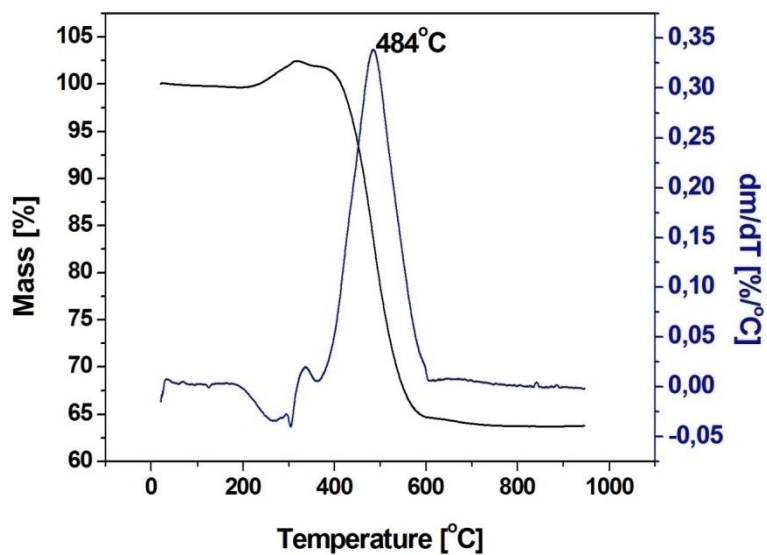


Figure S62. Thermogravimetric curve for CEINs treated with 1M  $\text{CuCl}_2$  at boiling point.

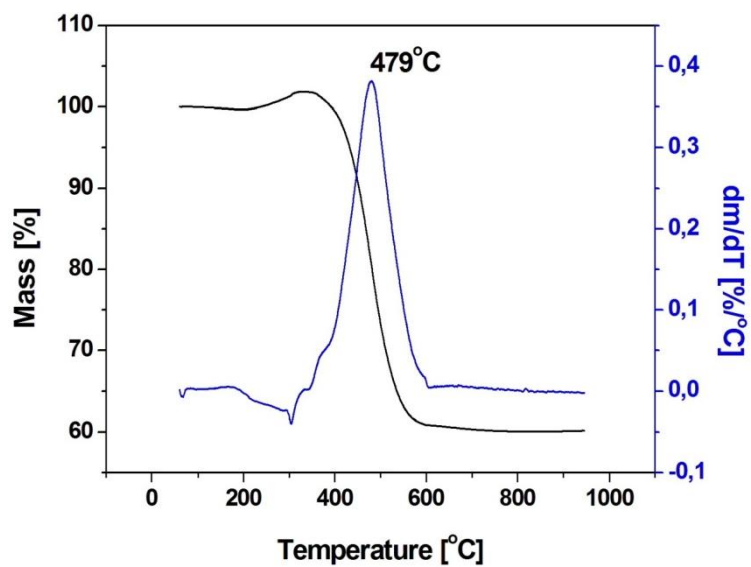


Figure S63. Thermogravimetric curve for CEINs treated with 3M  $\text{CuCl}_2$  at boiling point.

## Raman spectra

(corrosion agent and corrosion conditions are listed below each spectrum)

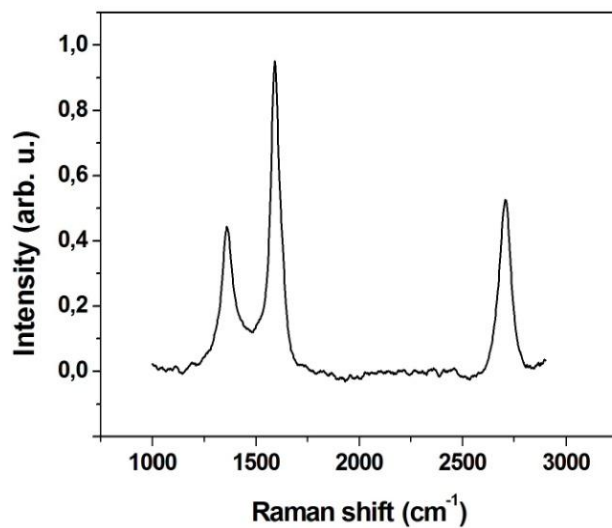


Figure S64. Raman spectrum for CEINs treated with 1M AgNO<sub>3</sub> at boiling point.

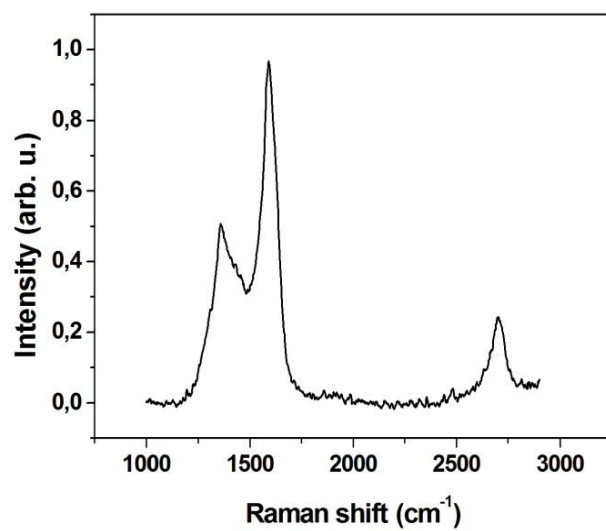


Figure S65. Raman spectrum for CEINs treated with 5M AgNO<sub>3</sub> at boiling point.

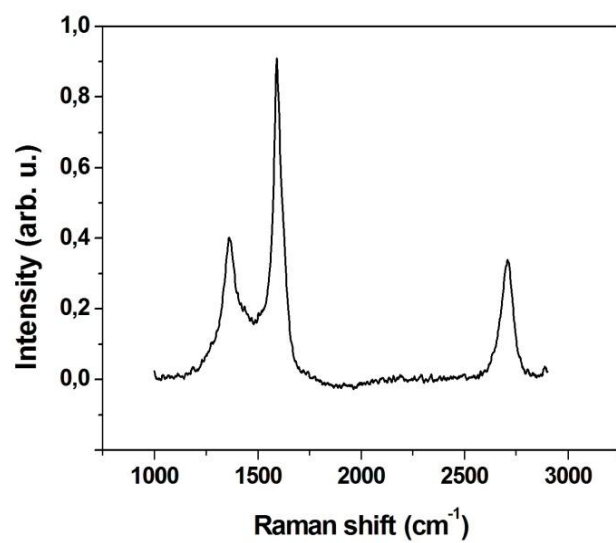


Figure S66. Raman spectrum for CEINs treated with 1M CuCl<sub>2</sub> at boiling point.

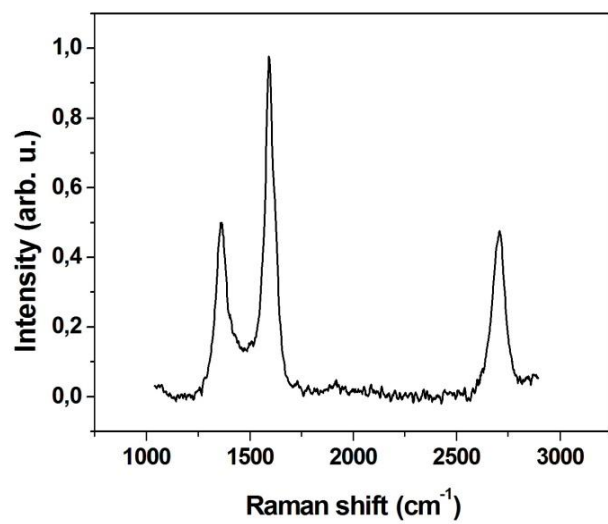


Figure S67. Raman spectrum for CEINs treated with 3M CuCl<sub>2</sub> at boiling point.

### Magnetic hysteresis loops

(corrosion agent and corrosion conditions are listed below each curve)

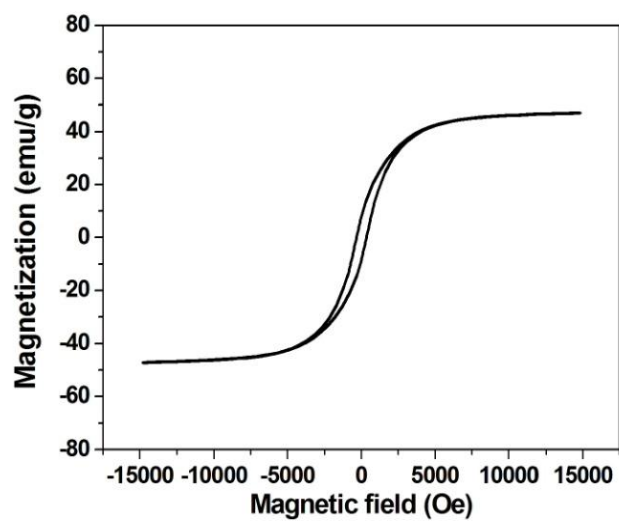


Figure S68. Magnetic hysteresis loop for CEINs treated with 1M  $\text{AgNO}_3$  at boiling point.

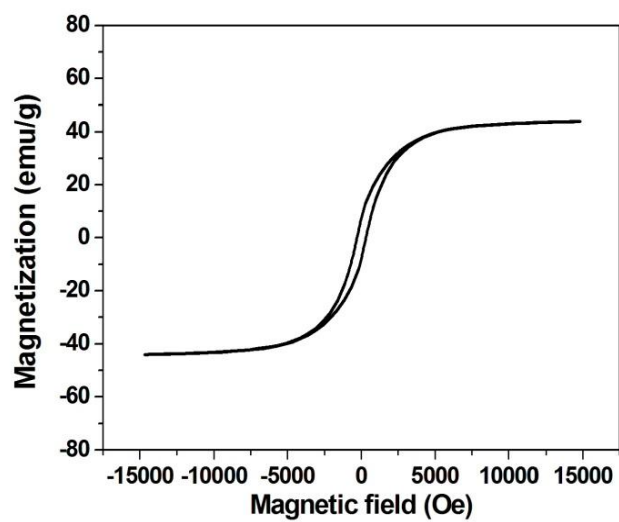


Figure S69. Magnetic hysteresis loop for CEINs treated with 5M  $\text{AgNO}_3$  at boiling point.

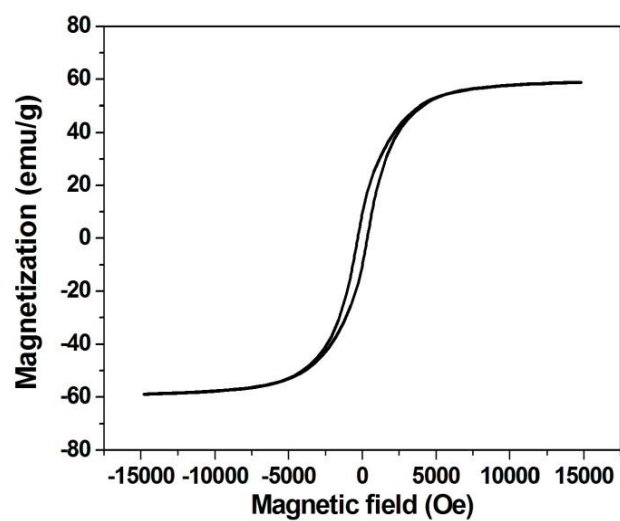


Figure S70. Magnetic hysteresis loop for CEINs treated with 1M CuCl<sub>2</sub> at boiling point.

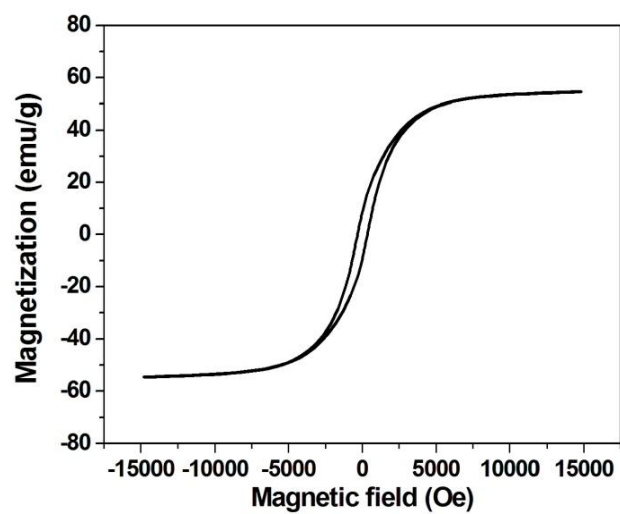


Figure S71. Magnetic hysteresis loop for CEINs treated with 3M CuCl<sub>2</sub> at boiling point.

## Analyses for carbon-encapsulated iron nanoparticles treated with ionized gases

### Thermogravimetric curves

(corrosion agent and corrosion conditions are listed below each curve)

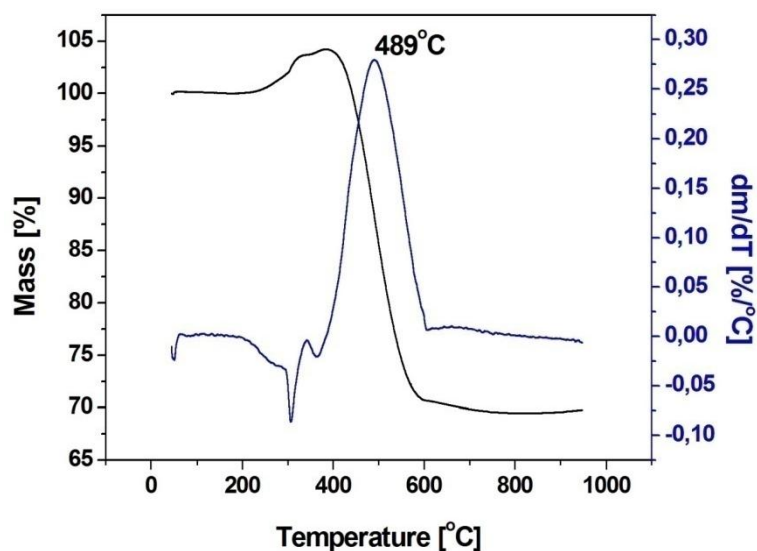


Figure S72. Thermogravimetric curve for CEINs treated with ionized oxygen, before purification.

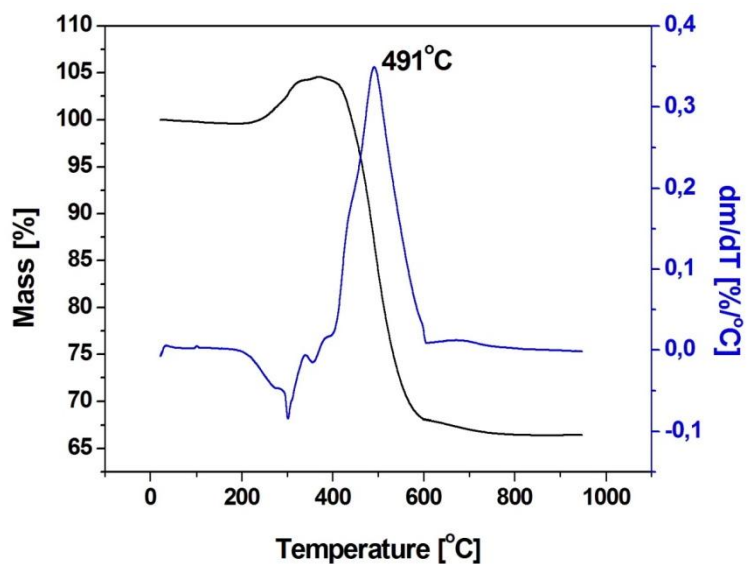


Figure S73. Thermogravimetric curve for CEINs treated with ionized oxygen, after purification.

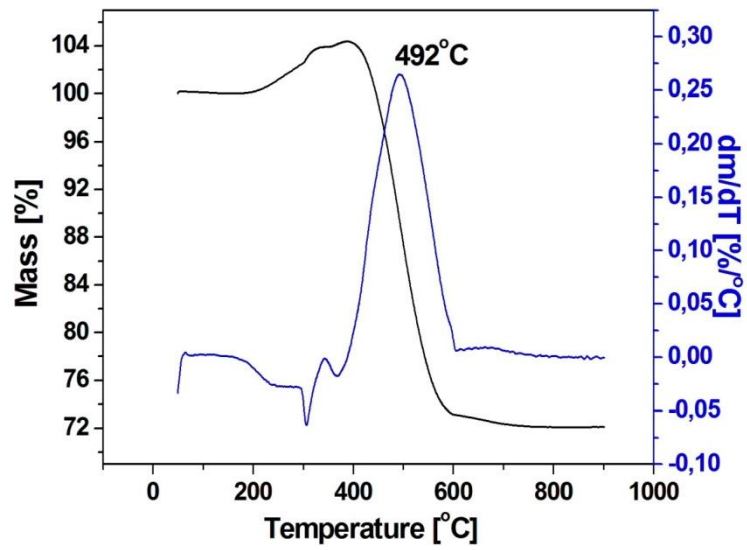


Figure S74. Thermogravimetric curve for CEINs treated with ionized ammonia, before purification.

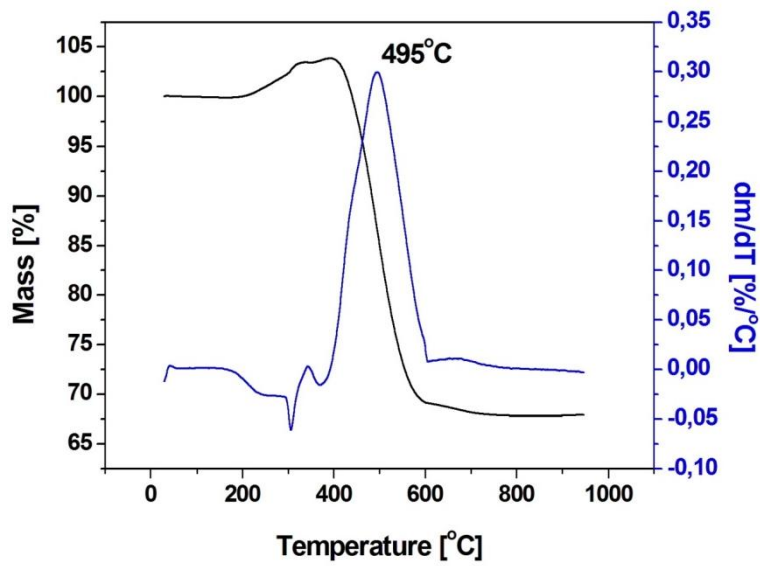


Figure S75. Thermogravimetric curve for CEINs treated with ionized ammonia, after purification.



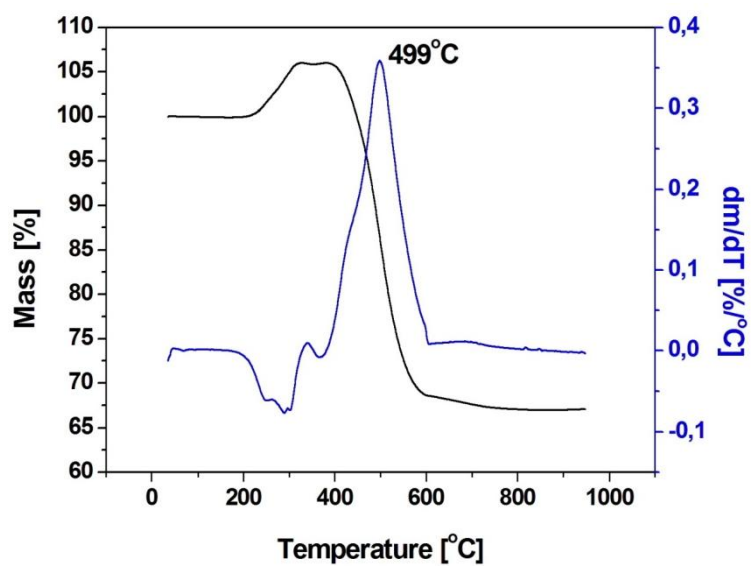


Figure S76. Thermogravimetric curve for CEINs treated with ionized argon, before purification.

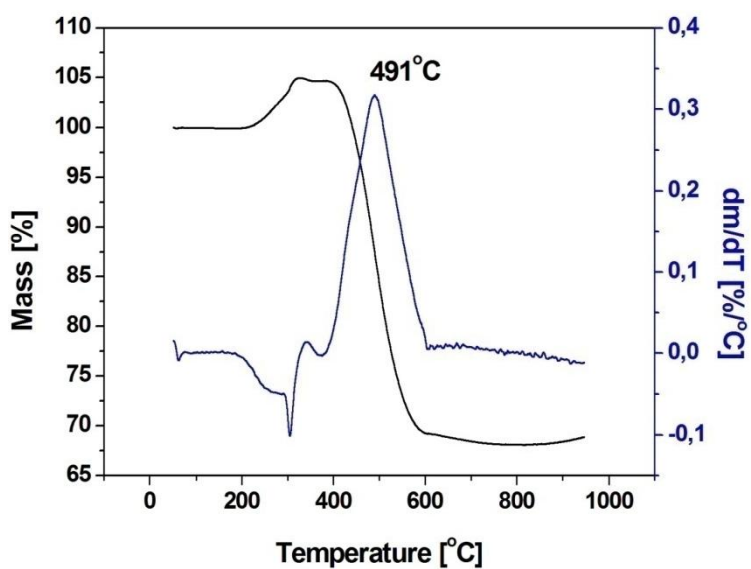


Figure S77. Thermogravimetric curve for CEINs treated with ionized argon, after purification.

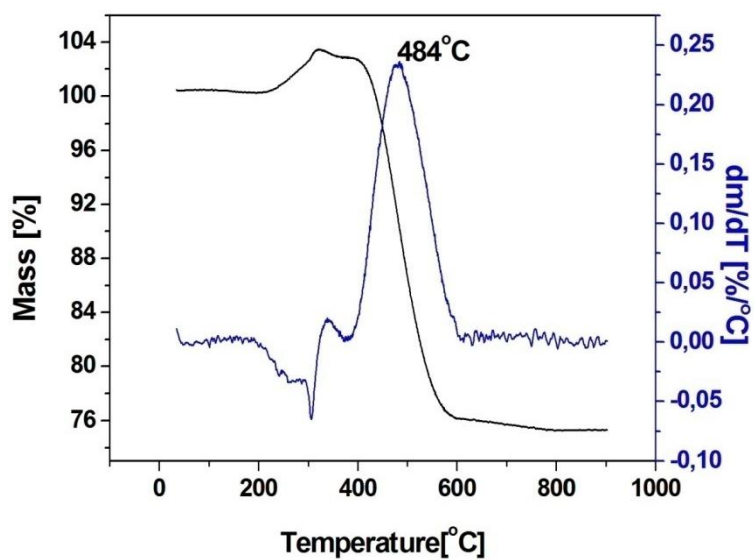


Figure S78. Thermogravimetric curve for CEINs treated with ionized water vapor, before purification.

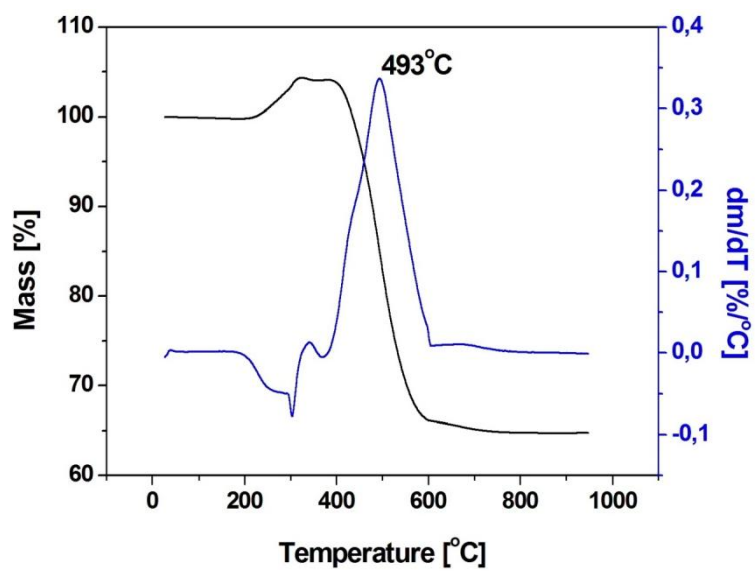


Figure S79. Thermogravimetric curve for CEINs treated with ionized water vapor, after purification.

## Raman spectra

(corrosion agent and corrosion conditions are listed below each spectrum)

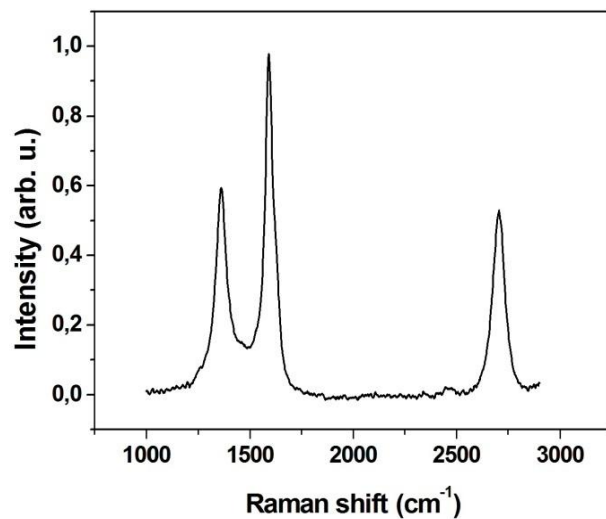


Figure S80. Raman spectrum for CEINs treated with ionized oxygen, after purification.

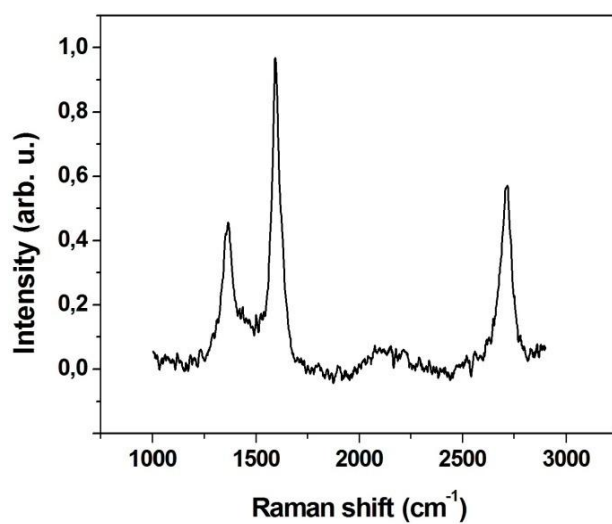


Figure S81. Raman spectrum for CEINs treated with ionized ammonia, after purification

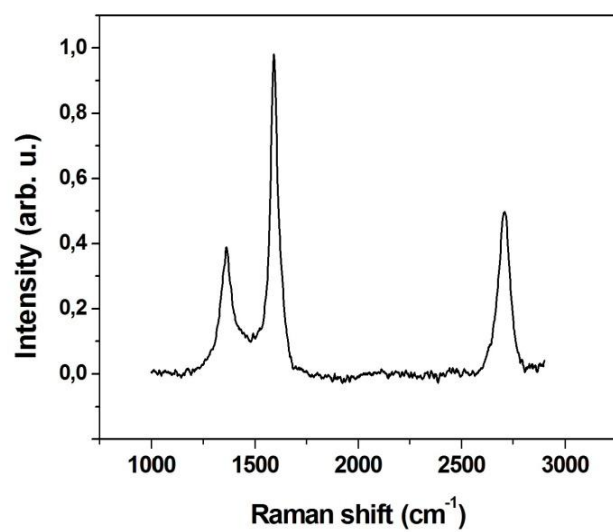


Figure S82. Raman spectrum for CEINs treated with ionized argon, after purification

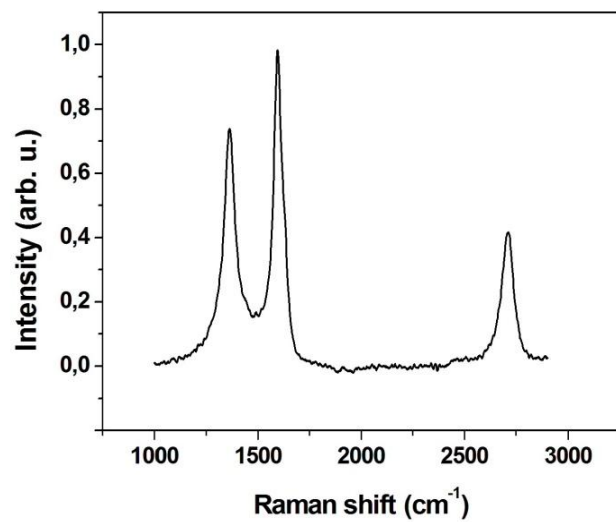


Figure S83. Raman spectrum for CEINs treated with ionized water vapor, after purification

### Magnetic hysteresis loops

(corrosion agent and corrosion conditions are listed below each curve)

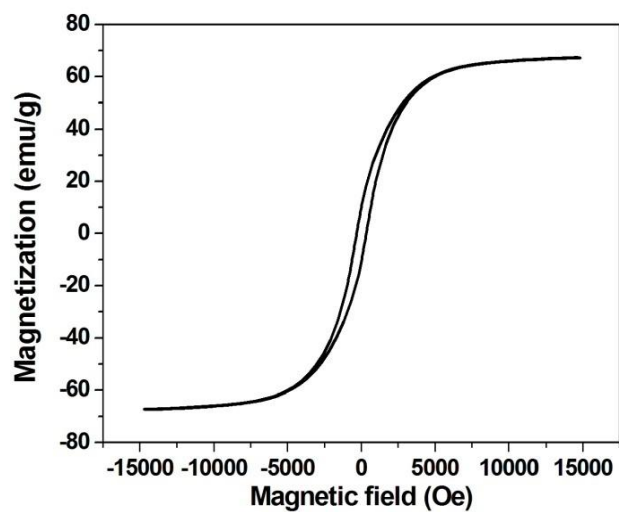


Figure S84. Magnetic hysteresis loop for CEINs treated with ionized oxygen, after purification.

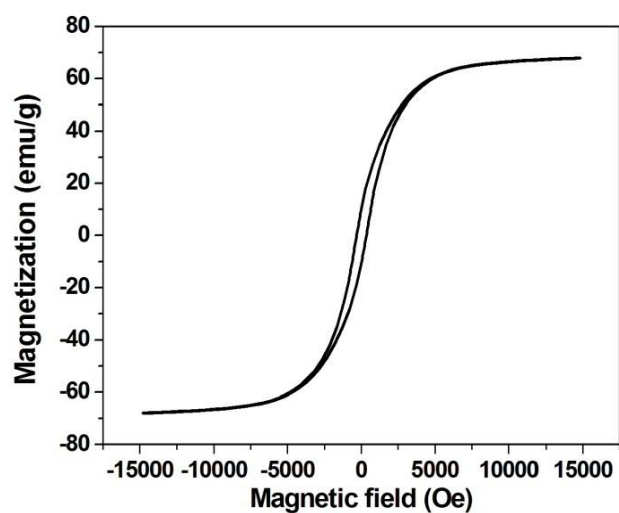


Figure S85. Magnetic hysteresis loop for CEINs treated with ionized ammonia, after purification.

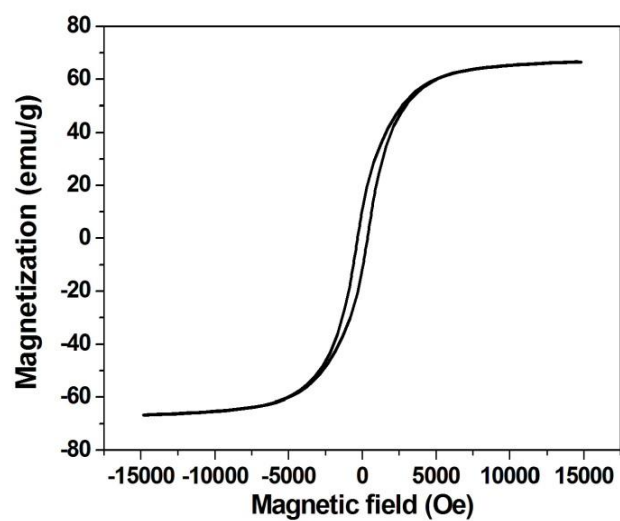


Figure S86. Magnetic hysteresis loop for CEINs treated with ionized argon, after purification.

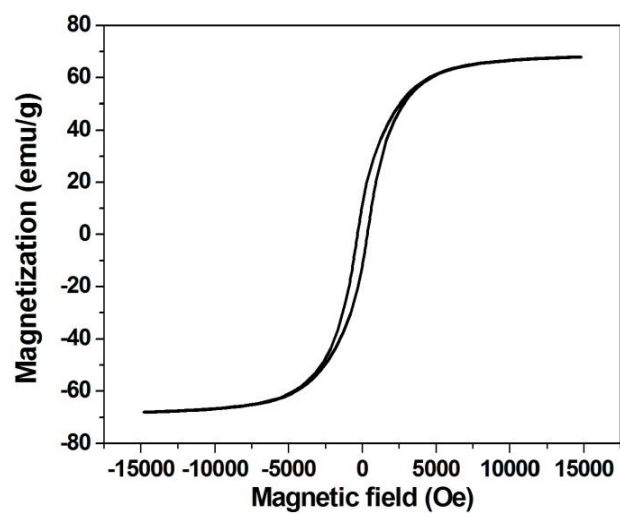


Figure S87. Magnetic hysteresis loop for CEINs treated with ionized water vapor, after purification.