Insight into the Mechanism of Graphene Quantum Dot Formation via the Photo-Fenton Reaction

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Introduction

Graphene represents an attractive two-dimensional carbon-based nanomaterial that holds great promise for applications such as electronics, batteries, sensors, and composite materials. Recent work has demonstrated that carbon-based nanomaterials are degradable/biodegradable, but little work has been expended to identify products formed during the degradation process. Because these products may have toxicological implications that could leach into the environment or the human body, insight into the mechanism and structural elucidation remain important as carbon-based nanomaterials become commercialized.

Results and Discussion

Here, we provide insight into a potential mechanism of graphene oxide degradation via the photo-Fenton reaction. We have determined that after one day of treatment intermediate oxidation products (moleclular weight, 150-1000 Da) are generated (see **Figure 1**). Upon longer reaction times (i.e., days 2 and 3), those products are no longer present in high abundance, and the system is dominated by graphene quantum dots (GQDs). Based on FT-IR, MS, and NMR data, potential structures for these oxidation products, which consist of oxidized polycyclic aromatic hydrocarbons, are proposed.

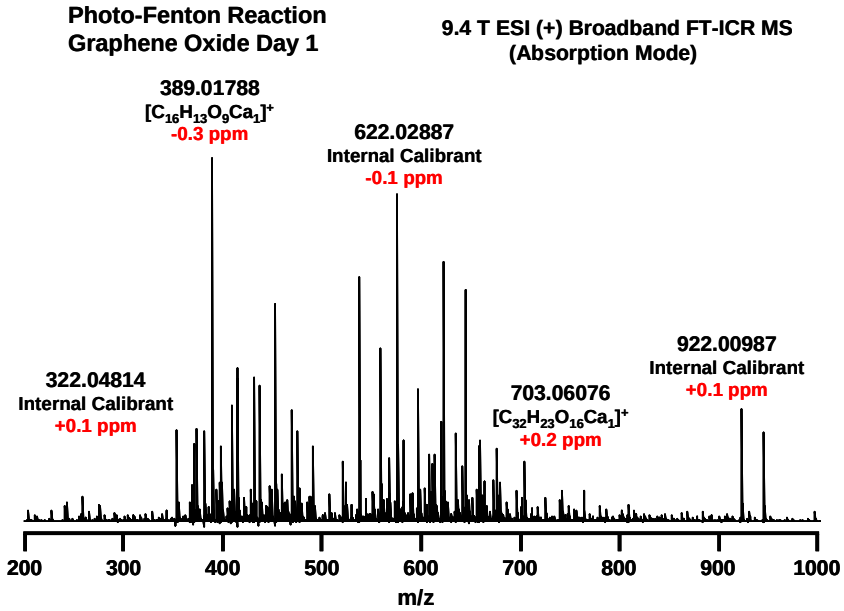

Fig. 1 Precursor ion mass spectra derived by positive-ion electrospray Fourier transform ion cyclotron resonance for graphene oxide after 1 day of treatment with the photo-Fenton reaction.

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References

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