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γ-Iron Phase Stabilized at Room Temperature by Thermally Processed Graphene Oxide

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Abstract

© 2018 American Chemical Society. Stabilizing nanoparticles on surfaces, such as graphene, is a growing field of research. Thereby, iron particle stabilization on carbon materials is attractive and finds applications in charge-storage devices, catalysis, and others. In this work, we describe the discovery of iron nanoparticles with the face-centered cubic structure that was postulated not to exist at ambient conditions. In bulk, the γ-iron phase is formed only above 917 °C, and transforms back to the thermodynamically favored α-phase upon cooling. Here, with X-ray diffraction and Mössbauer spectroscopy we unambiguously demonstrate the unexpected room-temperature stability of the γ-phase of iron in the form of the austenitic nanoparticles with low carbon content from 0.60% through 0.93%. The nanoparticles have controllable diameter range from 30 nm through 200 nm. They are stabilized by a layer of Fe/C solid solution on the surface, serving as the buffer controlling carbon content in the core, and by a few-layer graphene as an outermost shell.

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