**Engineering iron oxide nanoparticles for magnetic hyperthermia in cancer treatment and biosensing applications**

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The unique properties of nanomaterials at the nanoscale have opened exciting research avenues. Iron oxide-based magnetic nanoparticles (IONPs) are a promising candidate for a new cancer therapy approach that combines radiation with heat treatment (magnetic hyperthermia). While already approved by the FDA for medical imaging and anemia treatment, MNPs designed for magnetic hyperthermia require specific characteristics. These properties influence how efficiently they convert magnetic energy into heat, the amount of heat produced, their surface chemistry, and how they interact within an external magnetic field. Recent decades have seen the development of a new generation of IONPs specifically tailored for this purpose. One promising method involves assembling tiny nanoparticles into flower-like structures using a technique called polyol-mediated synthesis. This structure seems to be particularly effective for generating heat during magnetic hyperthermia treatment, possibly due to how the individual cores are arranged and interact. Additionally, these IONPs are relatively non-toxic and can be further modified with various coatings to improve their functionality. These features make polyol-prepared IONPs strong candidates for combination cancer therapy.

Moreover, combining nanostructured iron oxides with graphene-based materials creates nanocomposites that significantly enhance the performance of carbon-based electrodes in electrochemical sensors. These sensors offer high sensitivity and low detection limits for specific target molecules (analytes). Additionally, they exhibit selectivity for the target analyte and can be used with a wide range of real-world samples.