A Liquid-Liquid Extraction to Purify Magnetite Nanoparticles

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The purpose of this project is to develop a new and more efficient method for purifying magnetite nanoparticles. Magnetite nanoparticles are typically synthesized with the surfactant oleic acid in excess in order to prevent the particles from agglomerating. Before the magnetite can be used, the excess oleic acid must be removed from the magnetite nanoparticles. The standard process involves several precipitation and centrifugation steps and can take several days. In this project, I am attempting to develop a liquid-liquid extraction to separate magnetite nanoparticles from oleic acid more efficiently. After creating a series of ternary phase diagrams, I selected the two immiscible solvents methanol and decane for the high preference that oleic acid has for methanol over decane. Experiments conducted by a proxy, as COVID restrictions prevented me from accessing the lab, demonstrated that, in a liquid-liquid extraction, the nanoparticles preferentially dissolve in decane while oleic acid is found primarily in methanol. The separation is so clean that no nanoparticles are detected in the methanol while less than one percent of the oleic acid is found in the decane phase. This method of liquid-liquid extraction is easy and fast, taking only a few minutes. Additionally, it provides cleaner nanoparticles than the traditional precipitation route does after several days. This new approach is more efficient in terms of reagent usage and time and it yields a superior product.

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