# Functional metal oxide-based nanostructures and their applications

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## ABSTRACT

Metal oxides, particularly superparamagnetic iron oxide nanoparticles (SPIONs) and SPION-based materials, are being widely studied in many fields, from biomedical applications to improving the mechanical properties of composites. Due to their unique magnetic properties, they offer a broad spectrum of properties that can improve the physicochemical properties of a wide variety of materials in both solid and liquid states. Their application depends on size, shape, organic or inorganic surface coatings, and magnetic properties, which can vary depending on the synthesis method. Here, the role of experimental conditions during the synthesis and surface modification of SPION and SPION-based materials and their impact on potential applications like the change of microstructure of the resin-based composites filled with metal oxide fillers will be presented. Since the role of these materials in composites can also be dependent on the conditions of post-synthesis sample treatment, such as drying, particle concentration, media viscosity, vapor pressure, solution surface tension, temperature, pressure, and even the presence of a magnetic field, the influence of these conditions will also be discussed based on the experimental results obtained for magnetorheological fluids and magnetic composites and nanocomposites containing functional metal oxides.

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