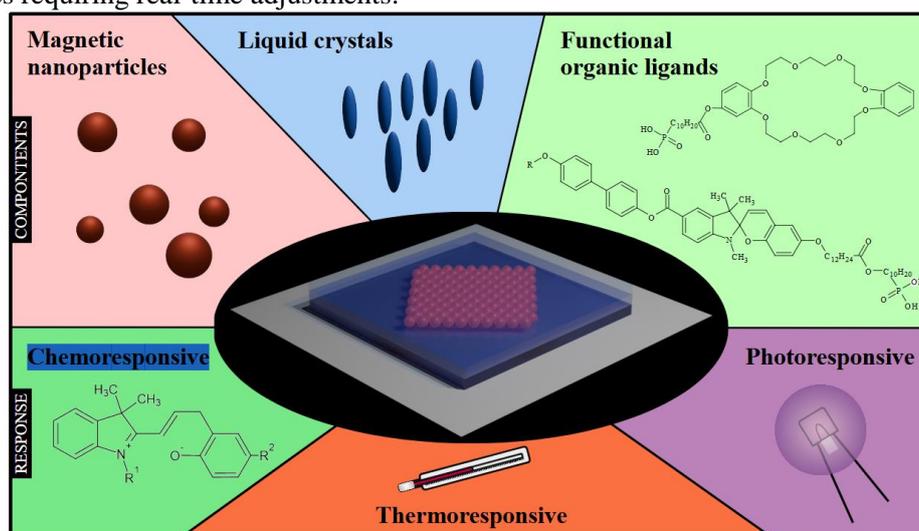


*Advanced structural control and long-range organization of magnetic and magnetically doped nanoparticles in liquid crystal systems for adaptively tuned, multi-stimuli responsive reconfigurable materials*

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The RESPO-MAG project explores the development of advanced materials that combine magnetic nanoparticles and liquid crystals to create dynamic systems capable of responding to various external stimuli, such as UV light, temperature changes, and chemical interactions. The primary goal is to design innovative materials that can reorganize their structure and magnetic properties on demand, opening up new possibilities for technologies like data storage, spintronics, and quantum computing. Magnetic nanoparticles, such as superparamagnetic iron oxide particles (SPIONs), are known for their unique magnetic behavior. By functionalizing these particles with liquid crystal molecules and special ligands, the project aims to create hybrid materials that combine fluid-like flexibility with the order and responsiveness of crystalline structures. This innovative approach allows precise control over the particles' spatial arrangement and magnetic characteristics. At the heart of the research lies the concept of reconfigurability. Unlike conventional materials, which remain static, the systems developed in RESPO-MAG can change their structure and properties under specific conditions. For example, exposing the material to UV light can trigger a change in its configuration, allowing it to adapt its magnetic or optical behavior. This dynamic adaptability makes these materials ideal for next-generation technologies requiring real-time adjustments.



**Figure 1.** The main ideas of the RESPO-MAG project is to fuse the gentle characteristics of liquid crystals with the ability of organic ligands to reversibly and externally control self-organization. This approach seeks to develop a new type of hybrid magnetic material that is reversibly self-organized. If successful, it could pave the way for exciting advancements in achieving thermal, optical, or chemical control over delicate magnetic states.

The project also investigates how these materials can address challenges in spintronics and quantum technologies. Magnetic nanoparticles are key components in these fields, offering the potential for high-performance memory devices and quantum bits (qubits) that store and process information at unprecedented scales. By improving the stability and coherence of magnetic states, RESPO-MAG aims to overcome existing limitations and pave the way for practical applications in quantum systems. The project team combines expertise in chemistry, nanotechnology, and material science, employing state-of-the-art techniques to synthesize, analyze, and test the materials. Their efforts focus on achieving a balance between innovation and functionality, ensuring the materials are both cutting-edge and applicable to real-world challenges. By unlocking the potential of hybrid magnetic materials, RESPO-MAG could lead to significant advancements in fields ranging from advanced computing to smart sensors and energy-efficient devices. This research not only pushes the boundaries of what materials can achieve but also sets the stage for transformative technological innovations in the years to come.