

### **Project 3.10. Chemistry and photophysics of molecules in nanocavities**

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**ICP PAS Group:** Photophysics and spectroscopy of photoactive systems: structure and reactivity of systems with hydrogen bonds

**www:** [photoscience.pl](http://photoscience.pl)

#### **Background:**

The environment of chemical molecules affects their properties and reactivity. The strength of this influence depends very much on the properties of this environment. A special case of such an environment are nanocavities formed by metal nanoparticles (in particular metals with good plasmonic properties) and some semiconductors, which, in properly selected conditions, can dramatically increase, e.g., the likelihood of interaction of a molecule placed in such a cavity with light. In fact, the nanostructure creating such a cavity determines the strength of this interaction by effectively focusing the electromagnetic energy of light in the cavity. Depending on the specific properties of the nanocavity and the material it is made of, the mutual interaction of the cavity material and light can induce various physical and chemical processes in the molecule, e.g., electron transfer from the cavity material to the molecule and induction of (photo)chemical reactions. To fully exploit the potential of this type of systems in chemical reaction studies, it is necessary to understand better the interactions between a molecule, nanocavity, and light. In particular, this can be achieved by developing techniques for preparing well-defined nanocavities (with almost atomic accuracy) and by developing the technique of recording surface-enhanced Raman scattering (SERS) spectra with high temporal resolution, enabling tracking changes in the state of the molecule placed in the nanocavity.

#### **Aim:**

The aim of the project is to investigate the possibility of determining the state (spatial orientation, structure, etc.) and controlling the chemical reactions of molecules placed in nanocavities (including single nanocavities and single molecules) using surface-enhanced Raman spectroscopy (SERS) and surface-enhanced fluorescence techniques.

#### **Requirements:**

MSc diploma in physics or chemistry. Good knowledge of physical chemistry or chemical physics. Experience in spectroscopy or optics. General knowledge or experience in nanoscience, plasmonics, Raman and SERS spectroscopy, scientific instruments building would be an advantage.