Nanotechnology, a multidisciplinary scientific undertaking, involves creation and utilization of materials, devices or systems on the nanometer scale. This proposal calls for developing advanced nanostructured materials, which would possess unique combination of physico-chemical functionalities with optical and plasmonic properties, including the capability of optimized nonlinear optical response. The main platform for engineering the novel range of functionalities will be luminescent nanoparticles prepared by solution wet chemistry methods (Fig.1). Such nanoparticles will be used as building blocks which will be further conjugated with each other, either by tethering a bifunctional ligand or growing a core-shell structure, resulting in new interesting and perhaps yet not foreseen photonic properties. The target of those studies will be broadening of the understanding how different active nanostructures placed in close contact may affect each other's properties in nanoscale regime to provide the required physico-chemical functionalities. Additionally, the project will contribute to the knowledge of light-matter interaction at the nanoscale.

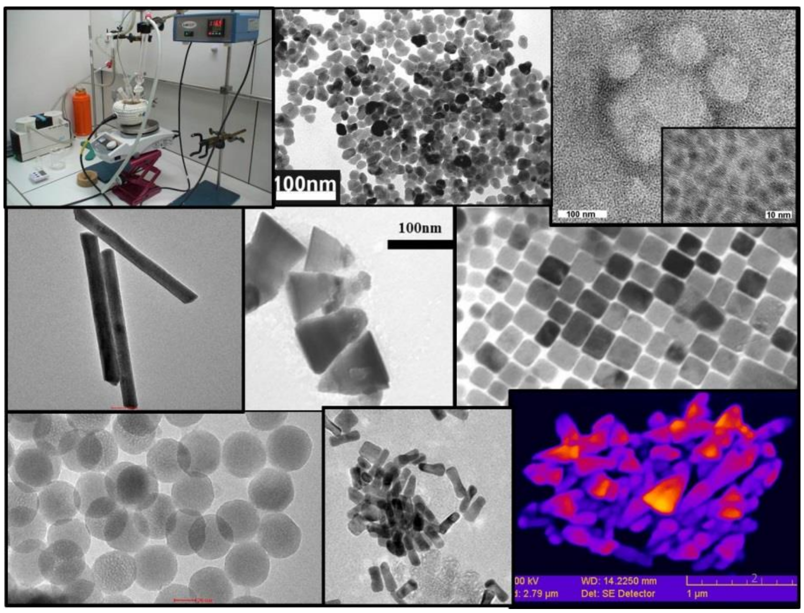

Fig. 1 *Schlenk's* line for wet chemistry method and representative TEM/SEM images of selected and varied morphology colloidal nanoparticles and quantum dots synthesized previously in our laboratory i.e.: $NaYF_4$, CdSe, ZnO.

Project proposes also a new nanotechnology approach and new method of nanomaterials optical characterization. The research included in postulated project is in no doubt interdisciplinary and cover many science disciplines such as: chemistry, material engineering, physics and photonics. In 21st Centry Nanotechnology will have huge impact on world industry and civilization. Nanomaterials, or matrices with at least one of their dimensions ranging in scale from ca. 1 to 100 nm, display unique physical and chemical features because of effects such as the quantum size effect, mini size effect, surface effect and macro-quantum tunnel effect. The optical and plasmonic properties of nanostructure materials differ significantly from their bulk counterparts. Therefore one of the main object of our postulated study in this project is to find procedures to relate the properties of hybrid nanomaterials to their structure, with special emphasis put on the wide spectra range nonlinear response (measurement of a third order electric susceptibility $\chi(3)$, with the use of the femtosecond laser techniques) of extended group of advanced nanostructured materials of colloidal hybrid nanomaterials with various shape, size and compositions, by defining and comparing the optical merit factors relevant for various photonic applications.