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Mechanochemistry of chitosan coated zinc sulfide (ZnS) colloidal nanocrystals for bio-imaging applications

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Zinc sulfide (ZnS) is one of the most important II-VI semiconductors. In this paper the ZnS nanocrystals have been prepared from precursors by a simple mechanochemical way using a high-energy dry milling in the first step. Structural, morphological and surface properties were studied. The cubic phase (sphalerite) with crystal size of ~5 nm was prevailing in the prepared ZnS sample. The obtained particles had irregular shape and the sample exhibited large value of the specific surface area (S_A = 126 m^2/g).

In the next step, ZnS nanocrystals were subjected to wet ultra-fine milling in chitosan solution (0.1 wt %). The suspension was stable and it reached high value of zeta potential (+51 mV). The changes in FTIR spectrum confirmed the successful surface coating of ZnS nanoparticles by chitosan.

The prepared ZnS nanocrystals possessed interesting optical properties verified *in vitro*. Four cancer cells were selected (CaCo2, HCT116, HeLa and MCF7) and after their treatment with ZnS-chitosan colloidal nanocrystals, the distribution of ZnS in the cells was studied using a fluorescent microscope. The particles were clearly seen, they passed through the cell membrane and accumulated in cytosol. The nanoparticles did not influence the biological activity of the cells, they did not cause cell death, and only the granularity of cells was increased as a consequence of cellular uptake. These results confirm the potential of ZnS nanocrystals in bio-imaging applications.

To sum up, it is possible to obtain stable colloidal biocompatible material for imaging purposes by a simple, two-stage mechanochemical approach.