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Luminescence and optical spectroscopy of condensed matter

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In this abstract, latest findings in luminescence quenching kinetics theory and advanced solid state laser experiments. Luminescence quenching kinetics is a popular and exceptionally useful tool to analyze the nanosized luminophores and laser material nanostructure. Quenching kinetics may be multistage, some stages having a complex, not exponential form. It is often the case for modern laser materials, which are nanostructurized, and for particular cases of energy transfer (such as cooperative down-conversion). We present compact and easy-to-use analytical expressions and computer simulation for various cases of nonexponential quenching kinetics: migration-accelerated quenching in bulk material; cooperative luminescence quenching in bulk material; and two extreme cases of energy transfer in nanoparticles - static and with superfast migration (both including cooperative case of luminescence quenching in ensembles of acceptors comprised of two-, three-, and more particles). We also review the most perspective laser experiments lately performed in our laboratory, including those on fluoride laser nanoceramics and materials for middle infra-red lasers.

Highlights:

- The law for far stage of static cooperative quenching, in particular, in nanoparticles
- Supermigration limit quenching in nanoparticles has a second, nonexponential, stage
- Oscillations in SrF2:Pr3+-the first ceramics working in visible spectral range 639 nm
- Middle infrared laser materials - ZnSe:Cr2+ and ZnMgSe:Cr2+, PbGa2S4:Dy3+

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Exploring the effects of solvent volatility on the fabrication of core-shell multilayered microfibers by triaxial electrospinning

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Triaxial spinneret is a novel modification in the electrospinning process to address controlled and sustained delivery of therapeutic agents from various fibrous mats. In this study, we evaluated the role of solvent properties and polymer molecular weights. We explored the formation core-shell hollow fibers using various combinations of polycaprolactone (PCL), cellulose acetate (CA), and polyvinyl alcohol (PVA), and mineral oil (as the inner core). Different solvent mixtures were tested based on their boiling points. Fiber morphology and size were evaluated by scanning electron microscopy. Solution viscosities were evaluated at various shear rates. Tensile tests (both wet and dry) were performed in addition to viability of human umbilical vein endothelial cells. Micrographs indicated the formation of hollow core-shell microfibers of outer hydrophobic PCL/CA, PCL/PVA and outer hydrophilic CA/PCL fibers. Fibers sizes were in micrometer range in all the formed configurations. Stripping of the outer CA in PCL confirmed the distribution of inner PCL. While switching the configuration of polymers in these systems, rapid solvent evaporation (volatility) of the inner core caused phase separation, leading to failure in obtaining fibers. Endothelial Cells attached and spread on these fibers suggesting no toxicity from the solvents. PCL-CA-Hollow fibers had increased stiffness and load carrying capacity than CA-PCL-Hollow fibers. Selection of solvents with appropriate boiling points relative to the outer shell is critical: outer shell should have a boiling point less than that in the inner cores. Inner core MW should be smaller or comparable to that of the outer shell.

Biography

Abdurizzagh Khalf got his master's degree from University of Stellenbosch (South Africa) in 2009. Currently, he is a full time chemical engineering Ph.D. student at Oklahoma State University where, he works with Dr. Sundar Madihally. He is broadly interested in electrospinning nanofibers and nanofibers characterization.

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