materials exhibit magnetic properties which are interesting both from fundamental research of magnetism as well as for applications. Nanocomposite exchange coupled magnets, spring-magnets, consisting of a fine mixture of hard (to provide high coercivity) and soft (to provide high magnetization) magnetic phases, which are coupled by exchange interactions, have attracted much attention for potential permanent magnet development. Additionally to the predicted high energy product as 1090 kJ/m^3, the present of Fe or Fe based phases in exchange spring magnets is promising for a better thermal stabilities, higher corrosion resistance and low prices for this magnets. The exchange-spring behaviour can be understood on the basis of the intrinsic parameters of the hard and soft magnetic phases which are coupled by exchange interactions. However, the role of the microstructure in the spring mechanism is not well understood. The experimental studies, relating to the influence of the microstructure on the hard/soft exchange coupling, have the advantages of different microstructures obtained by dedicated techniques: rapid solidification, mechanical milling/alloying, plastic deformation, thin film multilayers etc. The importance of the phase composition, including fine substituting/doping elements, is also well exploited.

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SOLID-STATE LASERS MATERIALS: FROM BULK TO MICRO- AND NANOCRYSTALS.

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In the past 50 years since the first demonstration of the ruby laser (Cr^{3+}:Al_2O_3), numerous types of solid state lasers have been developed [1]. In the first decade of solid- state lasers research many systems have been realized from bulk crystals as the Nd:$Y_3Al_5O_{12}$ (Nd:YAG) laser. Traditionally, these laser crystals were grown from the melt by the Czochralski technique as large boules from where rods were prepared for lamp-pumped lasers. With the advances of semiconductor lasers in the 1980s, the demands of laser crystals changed in view of the development of diode-laser pumped systems, which allowed laser devices from crystals with smaller dimensions. Besides, this technology made possible the investigation of several other systems based on rare earth ions and transition metals in various host crystals, resulting in a wide range of solid-state gain media for different wavelength regions. The increasing demand of compact laser light sources and lower costs resulted also in the development of fiber lasers usually identified as lasers with optical fibers (glass fibers) as gain media, which fabrication techniques are well known. Nevertheless, new technologies continue being examined, as for example, the single crystal fiber lasers and random lasers. The first combine the advantages of bulk crystals (high emission cross sections and good thermal conductivity) and fiber lasers (good beam quality and good thermal management). The recent development of random lasers has shown that it is possible to obtain laser action in disordered structures such as powders [2].In this work we review concisely the crystal growth technologies employed and describe progress of our group in optimizing crystal growth as well as laser tests with fluorides and tungstates for single fiber lasers and nanoparticles for random laser studies. Single fibers were grown by the micro-pulling down method and nanoparticles synthetized by the sol-gel method. The samples were characterized as to optical and structural properties and prepared for laser tests by special lapping techniques in the case of single crystal fibers. The fibers were tested under diode-pumping and a gain and loss analysis was made. Random lasing was achieved with the nanopowders and fraction of stimulated emission and upconversion was measured.* Research supported by CNPq and FAPESP (Brazil).