# Des micro-aimants pour des applications biomédicales

Permanent magnets are ubiquitous, being exploited in the motors of many electrical appliances, in sensors, for latching… There is an ever increasing demand for high performance RE-TM bulk magnets for use in the clean energy sector (electric and hybrid vehicles, gearless wind turbines). At the same time, there is much potential for the use of these types of magnets in micro-systems, and the volume force they can apply on another magnetic object scales up as the size of the magnet scales down (this may be likened to the way that an ant can carry a load of a relative mass much greater than say a horse or an elephant can). The strong forces achieved with micro-magnets can be used for the efficient manipulation (trapping, sorting, mixing…) of micro-objects. Compared to other micro-flux sources (electro magnets, soft magnetic elements), they have the advantage of being compact and autonomous, requiring neither a powder supply, nor an external magnetic field to maintain their stray magnetic field.

Researchers at Institut Néel have developed the fabrication of RE-TM materials in thick film form, and have developed original lateral patterning methods for these films. In a first technique, called “topographic patterning”, they use clean room facilities (lithography, etching…) to define micron-scaled patterns in Si substrates, upon which the hard magnetic film is then deposited. In a second technique, called “thermo-magnetic patterning”, they use laser irradiation through a mask to locally heat the hard magnetic film, in the presence of an external magnetic field. The direction of magnetization of the heated regions is determined by the direction of the applied magnetic field. In both cases, the patterning of the magnetic film (physical and magnetic, respectively), leads to the formation of stray field patterns that are characterized by extremely high magnetic field gradients.

Micro-flux sources are being developed for a range of bio-medical applications, such as lab-on-chip cell sorting for biological analyses, in-vivo capture of biomarkers for the early detection of cancer, and for more fundamental studies (influence of field gradients and magnetically mediated forces on cell development), in the framework of a number of national and international collaborations with biologists and doctors.