# Fabrication of lithographic nanoparticles for biomedicine

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The use of magnetic nanoparticles for biomedicine is a growing area of research and has shown promising results in several applications including drug delivery, hyperthermia and MRI. Magnetic behavior of nanomaterials strongly depends on their dimensions and geometry. In this sense Lithography techniques allow to design nanostructures with specific magnetic properties due to the possibility to tune the size and shape of magnetic materials in a controlled manner. Specifically, magnetic nanodiscs with spin vortex configuration are very promising for biological applications as they exhibit zero remanence so they do not agglomerate when they are dispersed in solution. Moreover, they rotate when an alternating magnetic field is applied. This mechanic oscillation was demonstrated to promote cancer cell destruction by the application of alternating magnetic fields of low amplitudes (100 Oe) and low frequencies (10's of hertzs)[1]. For this purpose vortex-state nanodiscs were fabricated by Interference Lithography, which allows to pattern large areas ($cm^2$) making possible mass production of nanoparticles. Our lithography system uses a Lloyd's mirror interferometer with a He-Cd laser ($\lambda$ = 325nm) as a light source. Two fabrication routes were explored by using either positive or negative-tone resists that yield dot and antidot resist templates, respectively. These two fabrication strategies comprise several steps including thermal evaporation of Permalloy (NiFe) and the release of the nanostructures into solution. A full characterization of submicrometric discs (Figure 1) and a magnetic response analysis is discussed for each fabrication process comparing pros and cons for both strategies, which provide suitable lithographic nanoparticles for biomedical assays.

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## References

[1] D. H. Kim et al, Nature Materials, 9 (2010) 165

## Figures

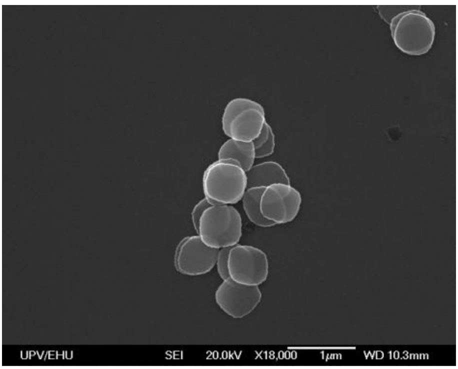


**Figure 1:** Scanning electron microscopy (SEM) image of released Permalloy disks dried on a Si substrate