

New magnetic field device for application with laser microscopes

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Abstract: A new digitally controlled field generator is integrated into a laser microscope. Magnetic particles powered non-invasively by the field generator treat cell populations inside a dish above the microscope lens, which can be observed in real time.

I. INTRODUCTION

Electro-Magnetism was defined in 1855 [1]. We use a magnetic circular field generator in order to interact with magnetic particles inside a microscope dish (Fig. 1).

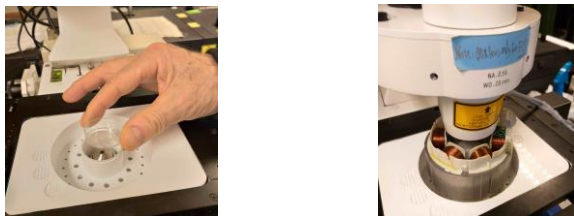


Figure 1. On the left: New microscope table with cooling slots enclosing the lens. On the right: The whole set up with field generator.

II. METHODS

The electro-magnetic equation set is the basis for the description of all electric events [2]. The unpaired spins of magnetic particles (BEADs) normally align along their easy axis's – in fact they oscillate between these directions – and they can be viewed as the BEAD's own magnetic field.

A strong incoming field (field generator) synchronizes (alignment) the BEAD-spin's and restructures hereby their energy landscape, meaning, the still existing easy axis inside the crystal are gaining an angle towards their magnetization vector M , which approaches the incoming field vector H . This effect causes above BEADs to move in order to minimize their energy.

III. RESULTS

We developed a device which is able to move particles without noticeable intrinsic particle heating. Figure 2 depicts the principle of the field generator system.

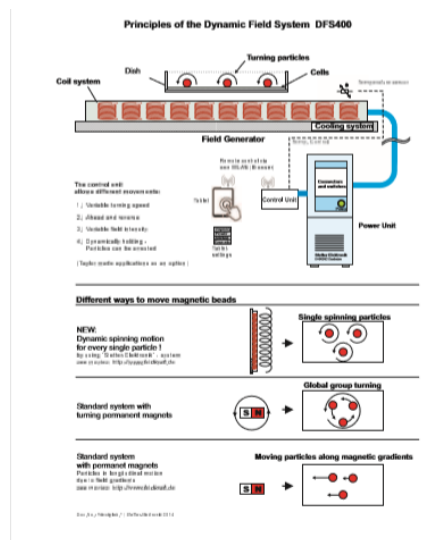


Figure 2. The field generator[2][3] is producing low frequent dynamic fields, hereby individually moving magnetic particles inside the dish (negligible heat generation inside the particles), which can be viewed in the microscope. All relevant data is stored automatically by the fully digitalized device.

IV. DISCUSSION

The magnetic particles (e.g. BEADs) integrated into cell-population (e.g. 3-D-spheres) allow further unheated treatment [3], like moving, wiggling or jamming.

REFERENCES

- [1] J.C.Maxwell, "On Faraday Lines of Force" The Scientific Papers of James Clerk Maxwell, Cambridge University Press, 1890, Vol.1, p.153.
- [2] G.Bosse, "Grundlagen der ElektrotechnikII", BI Mannheim, 1967, p.139.
- [3] E.Zhang, M.F. Kircher, M.Koch, L.Eliassen, S.N. Goldberg, E.Renstroem, "Dynamic Magnetic Fields Remote-Control Apoptosis via Nanoparticle Rotation", ACS Nano, 2014, pp.3192-3201