Development of a Laser Scanning Confocal Fluorescence Microscope compatible with a Florida-Bitter Magnet

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Regenerative medicine addresses the significant imbalance between the supply of organs and the need for transplants. A novel method for scaffold- and label-free biofabrication is the use of levitational assembly in high magnetic fields [1]. Living cells organized into tissue spheroids are preferred building blocks to form organ-like constructs. Since living cells are exposed to static magnetic fields for extended periods of time during this type of assembly, it is important to understand what effects these fields have on living cells. In cell biology and biofabrication, confocal fluorescence microscopy is an established method for visualizing cell morphology, functionality, their viability and following the formation of 3D bioconstructs. Here, we present the development of a customized, multicolor, laser scanning, confocal microscope that is compatible with a Florida-Bitter magnet (30 T, 50 mm bore). The design is based on a non-magnetic piezo-scan head, a telecentric optical relay line and a non-magnetic, sterile sample mount on a piezo nanopositioner in a fully temperature-controlled environment. We will describe the technical layout of the entire system and initial imaging experiments of fluorescent markers at different magnetic field strengths up to 25 T, which prove that our microscope design is viable (see Fig. 1). We will also present our first *in situ* studies of living (MC3T3) cells in magnetic fields, where we have labeled the cell nucleus and the tubulin cytoskeleton. Minor modifications of the microscope will also enable other types of experiments on soft matter with high magnetic fields or at magnetic field induced microgravity.

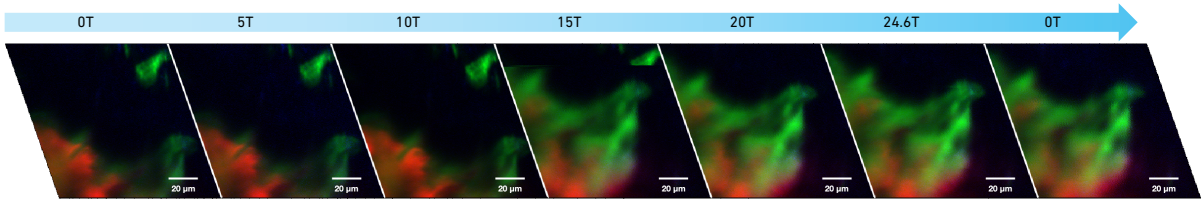

Figure 1: *Multicolor images of fluorescent marker excited at 375, 488 and 633nm, recorded with the homebuilt laser-scanning confocal microscope (40 x, 0.75 NA). From left to right images are shown of the sample exposed to increasing magnetic field strength (0 T to 24.6 T).*

[1] V. A. Parfenov *et al.* Biofabrication. 12 (2020).