# Precision Geometry Scaffolding using MEMS Technology

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Enabled by MEMS (semiconductor-based) technology, our group has produced a chainmail-based tissue scaffold out of polysilicon. We constructed the tissue scaffold through the combination of photolithography's high precision, the use of silicon dioxide and polysilicon material, and a planar chainmail structure (Figures 1 & 2). This approach allows uniform seeding, geometric features controlled on the micrometer scale, and folding of the scaffold into three-dimensional shapes.

The scaffold consists of 1-2 micron-thick polysilicon formed from a multilayer surface micromachining process. The layout is a planar process and uses the top two polysilicon layers to form a tessellation of interlocking rings with diameters of 250 and 500 microns and widths 10 and 25 microns, that are free from the silicon substrate but attached at a few breakaway anchor points.

The scaffold provides many advantages for tissue engineering: MEMS-based approach precisely controls the structure of the scaffold according to the resolution of photolithography (a few microns to submicrons); the chainmail form allows local rigidity and global flexibility; the entire area is a regular construction of polysilicon that allows uniform seeding; the chainmail structure allows folding (because of its interlocking ring structure) in order to fill arbitrary volumes as required in surgical implantation sites. The manipulative properties of chainmail permit much better shape and form control than is possible with currently available woven fabric designs.

In order to establish the feasibility of seeding and growing of cells on chainmail scaffolds, we used osteoblastic cells as a model for bone tissue engineering applications. Human MG-63 osteosarcoma cells were seeded in serum media conditions on sterilized chainmail scaffolds. Incubations were terminated at 24 hours and 7 days. Scaffolds were fixed and examined by electron scanning microscopy (SEM). Scaffolds were found to support cell attachment and growth in terms of surface features and geometry (Figure 3). As could be expected, the cell attachment and growth was not optimal on the unmodified polysilicon surface of scaffolds, however, with this successful planar design verification of the chainmail scaffold, our goal is to move to a biocompatable and bioresorbable scaffold to improve suitability for tissue engineering use.

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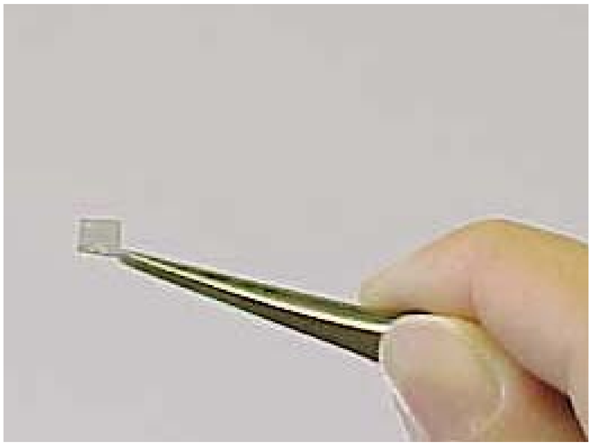

**Figure 1 - Researcher holding chainmail specimen.**

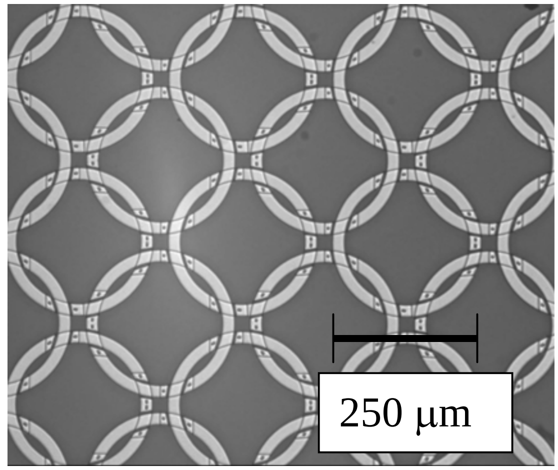


**Figure 2 - Optical microscope image of scaffold.**

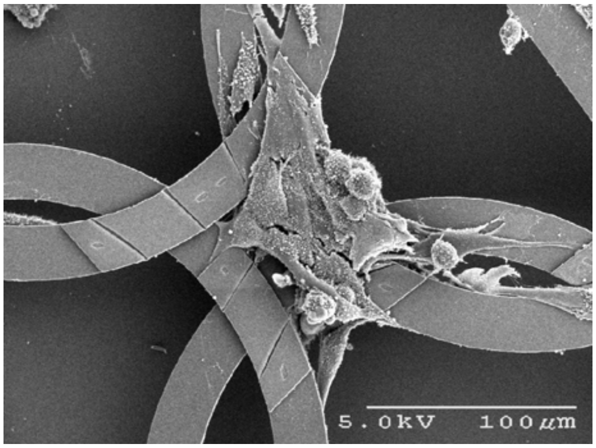


**Figure 3 - Close-up of seeded ring junction.**