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Non-Confidential Description - PSU No. 3483
"Fabrication of Nanoparticulate of High Aspect-Ratio Devices"

Keywords:

Powdered materials, sintering, medical instruments, minimally invasive surgery

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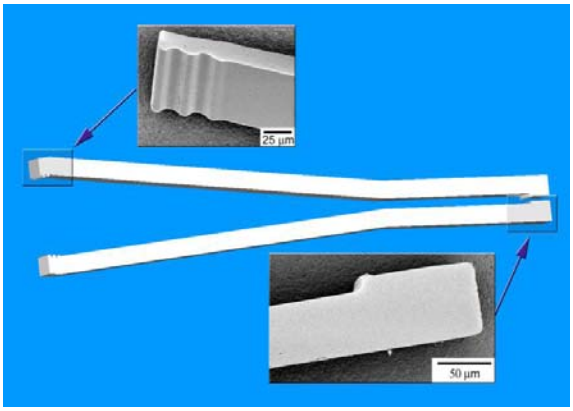

Fig 1: Close-up of nanoparticulate forceps

Background

Fabricating very small, but long, slender devices with high aspect ratios offers a challenge, pushing current manufacturing processes to their limits. Meanwhile, the need for such devices – and an improved manufacturing process – continues to grow, particularly for medical instruments used during minimally invasive surgical (MIS) procedures. Advances in MIS procedures (such as natural orifice translumenal endoscopic surgery) increase demand for smaller and more versatile instruments with diameters as small as 1 mm.

Invention Description

This invention describes a manufacturing process that allows the formation of very small, but very high aspect-ratio devices (length:diameter) that can have sharp edges and very high feature resolution. The process relies on the formation of molds using a modified ultraviolet lithography approach, gel casting of nanoparticulate materials, and sintering to full density. A variety of materials, including ceramics and metals, can be used in this process. A variety of tools and instruments have been created and progress continues with refinement of the manufacturing process. This process overcomes numerous challenges faced by the formation of tools by traditional machining (CNC, wire EDM), and other micro-fabrication techniques. Current research focuses on the manufacture of surgical instruments, but the process is not limited to this application.

Advantages / Applications

- Forms high aspect ratio devices: aspect ratio > 40
- Forms sharp edges: ~ 1 µm
- High degree of feature resolution: ~ 2 µm
- Allows for batch manufacturing
- Accommodates a variety of materials and allows tailoring properties

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