Nano scale machining of silicon using FIB structured diamond tools

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Abstract

Fabrication of periodic micro and nanostructures has novel application areas in optics, electronics, solar energy, and bioengineering. The ability of obtaining micro/nano structures on large surface areas would enhance the performance of products significantly. While techniques such as photolithography (electron beam, X-ray, etc.), focused ion beam milling, femtosecond laser machining, and scanning probe lithography are available, the challenge is to produce micro/nano structures with a higher productivity. Recently, diamond tools with nano features (obtained with FIB) on them have been produced and used in ultra-precision machines to obtain nano scale features on ductile materials such as copper and electroless nickel [Sun et al. 2012, Tong et al. 2015] and promising results have been obtained. It is important to obtain such features on materials such as silicon to enhance their optical properties in IR region. Unlike metals, silicon is a brittle material at room temperature and its ductile mode machining requires certain conditions to be satisfied so that crack-free surfaces can be obtained. Therefore, design and fabrication of nano features on the diamond tool and selection of machining conditions are crucial. In this study, nanostructured diamond tools (Fig 1a) with different desings were utilized in machining experimentals and nano scale machining on silicon in ductile mode have been achieved (Fig 1b). The results will be discussed in the presentation.

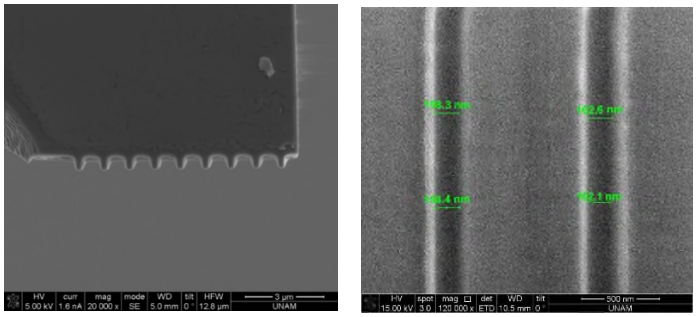

Figure 1: (a) FIB structured diamond tool, (b) Nano scale features machined on silicon.