Formation of Nano holes by an Electron Beam- Induced Etching Process

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The ability to induce localized etch and deposition processes becomes a critical task in nano-scale fabrication efforts. This is well demonstrated by the increasing use of Electron Beam Induced Processes enabling selective removal or deposition of a variety of materials, producing nano-scale features by rapid and accurate direct writing.

In this work we demonstrate the fabrication of nanometric holes in Si_3N_4 membranes, (Fig. 1) using a Raith E-Line system with a Xenon Fluorine- based precursor. In this process nano holes with controlled dimensions are repeatedly formed. We will show that the hole size and the repeatability of the Electron Beam Induced Etching (EBIE) process are controlled by a number of factors including the parameters of the electron beam (current and energy) and the gas injection system (precursor pressure and temperature), the precursor exposure cycle (exposure and refreshing duration) and the quality of the etched surface. Based on these studies a process window was found for the controlled fabrication of nano holes with diameter between 50-100nm. Nano holes with diameter less than 30nm were also achieved.

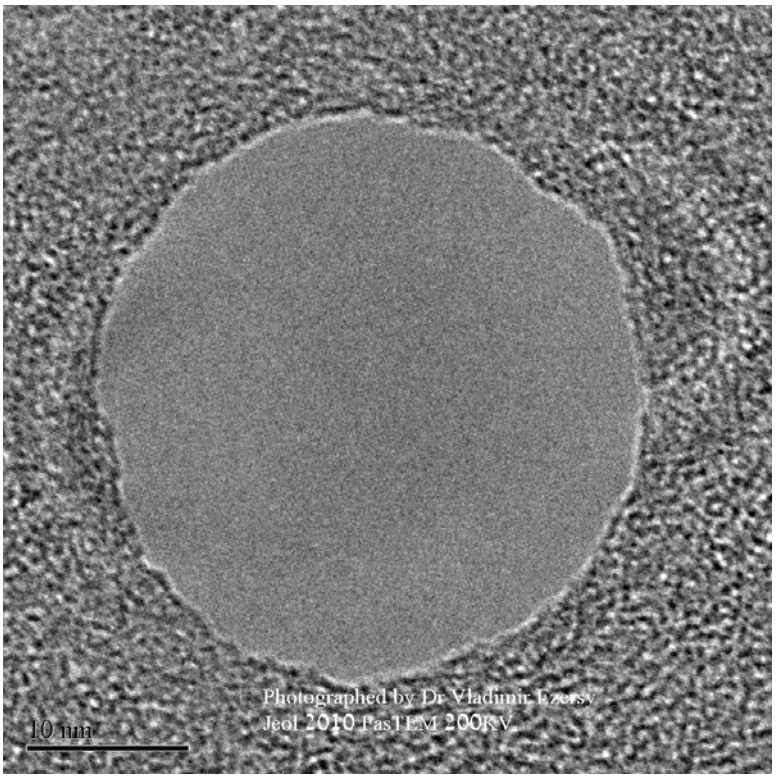

Fig.1: TEM micrograph of a nano hole made in a Si_3N_4 membrane (30nm thick ±10%, rms<2nm) by EBIE.