

# Executive Summary



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## 1. Title of the Project:

Prototype development + Incubation of a start-up company: Pattern creation at micro- and nano-scales using electric field-induced reaction and subsequent flow of liquefied reaction product.

## 2. Date of Start of the Project:

October 01, 2022

## 3. Aims and Objectives:

- Development of a prototype that utilizes the ability of the electric field to cause a chemical reaction (e.g., Cr and H<sub>2</sub>O) to create patterns at micro- and nano-scales.
- Optimization of the prototype and related process parameters to create microelectronics grade patterns ranging from 100 nm to 1000 μm in width.
- Field trial and commercialization of the prototype (through a start-up to be incubated at IISc) that can produce moderately high-resolution patterns at moderately high-throughput: This fills a niche application space(s) on the “throughput-resolution” plot.

#### 4. Significant achievements (not more than 500 words to include List of patents, publications, prototype, deployment etc.)

A prototype for the Water-Electro-Lithography (W-ELG) has been fabricated and used to draw the preliminary patterns (see the picture below).

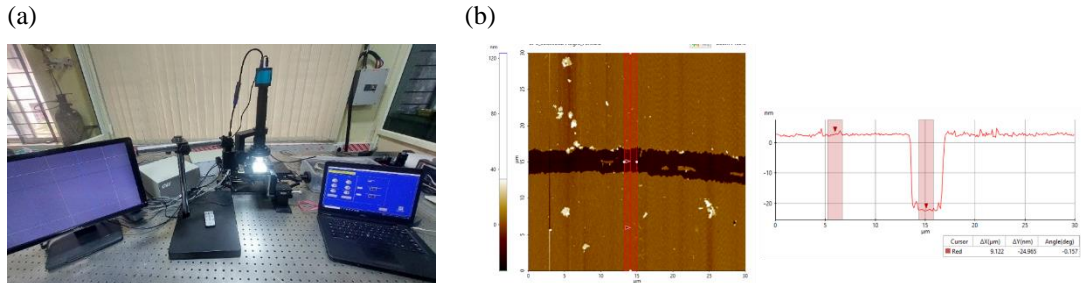


Fig. A: (a) A digital picture of the fabricated setup to perform W-ELG in the lab, and (b) an AFM profile of a line etched into Cr using WELG.

Systematic studies have been conducted to examine the effects of tip diameter, sample-to-tip distance and voltage on the resolution of the pattern (see the picture below).

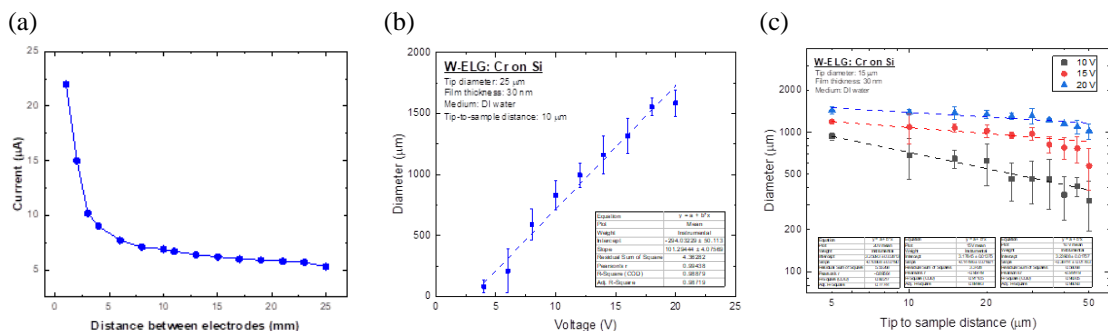


Fig. B: Variation of (a) electric current as a function of tungsten tip (cathode) and Cu electrode (anode) on current, and diameter of the pattern (e.g., resolution) as a function of (b) applied voltage and (c) tip-to-sample distance for various applied voltages.

#### 5. Concluding remarks

A prototype of a W-ELG setup is successfully built and demonstrated to create a few patterns. A few electric current parameters have been optimized and remaining are currently being optimized. Work is currently being done to establish correlations between setup parameters and resolution so that pattern resolution could fall within lower micrometers and upper hundreds of nanometers regime.