

An electrochemical etching method to fabricate a needle probe with a sharp tip and high aspect-ratio geometry

Ching An Huang*, J. H. Chang, C. C. Hsu,
S. Y. Yang
*Associate professor

Dept. Mechanical Engineering, Chang Gung University,
Taoyuan, Republic of China

Abstract

In this study, we proposed an electrochemical etching method to fabricate a needle probe in a diameter of several micrometers. The needle electrode made from harden-treated high carbon tool steel, SK 4, was preformed by using turning machine before the electrochemical etching. The anodic dissolution of the needle electrode in our proposed etchants can be classified in three different types: deburring, thinning without deburring, and deburring together with thinning. Furthermore, these three dissolution types can be obviously differentiated with their electrochemical behaviors. Based on the electrochemical behavior and dissolution type, the etchant for etching the needle electrode to form a needle probe with a sharp tip and high aspect-ratio geometry was successfully developed.

Keywords: high carbon tool steel, needle probe, electrochemical etching

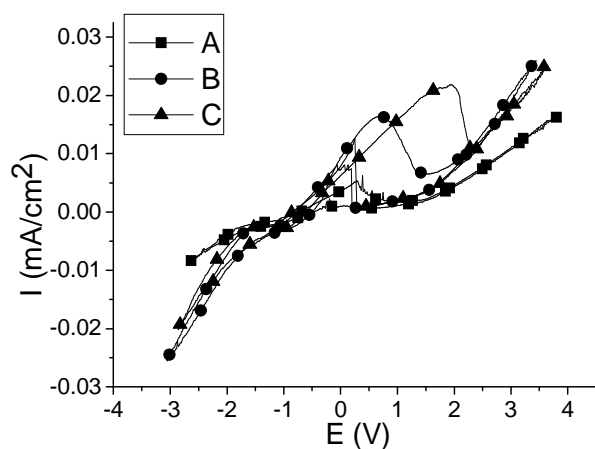


Fig.1 The cyclic voltammetry behaviors of the needle electrode in the etchants developed for deburring (A), deburring together with thinning (B) and thinning without deburring (C)

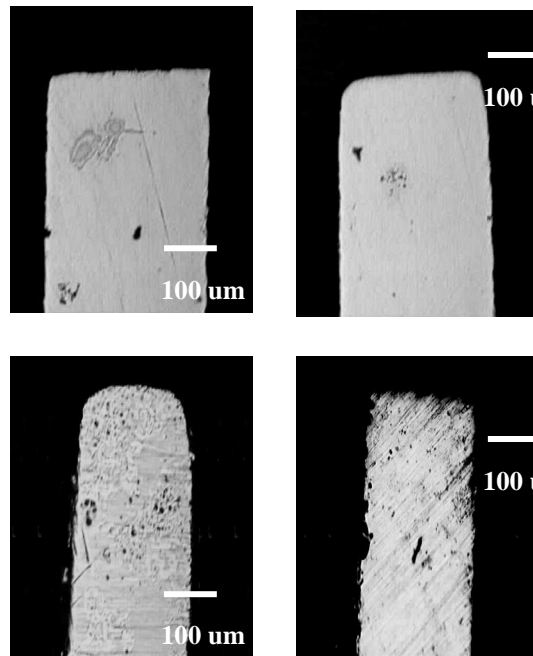


Fig. 2 Cross sectional views of the needle electrode in the conditions: (a) as-punched, and electrochemical etched with (b) deburring, (c) deburring together with thinning and (d) thinning without deburring.

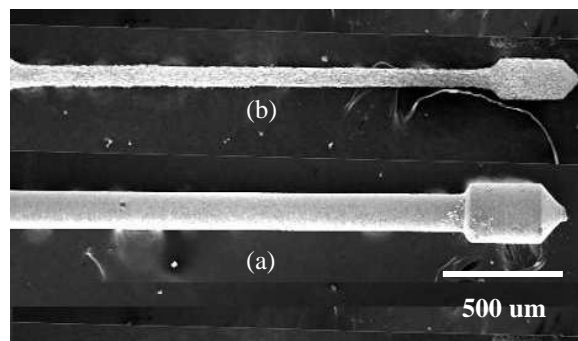


Fig. 3 (a) the needle electrode shaped by using turning machined, and (b) the electrode electrochemically etched to form a sharp-tip needle probe in the developed etchant