KELVIN PROBE MICROSCOPY IN CHEMICAL-ETCHED NON-POLAR ZnO THIN FILMS: POLARITY EFFECTS VS. DANGLING BONDS

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ZnO has recently become the object of extensive research efforts due to its potential applications in the fields of visible/UV optoelectronics, transparent electronics, spintronics, solar cells and catalysis [1]. In addition, it has shown up as the semiconductor exhibiting the richest family of nanostructures [2]. Nevertheless, in spite of the increasing ZnO applications some basic technological tools for the manufacture of future devices are still lacking. In particular, chemical etching of ZnO is a common intermediate process in device manufacture that has been scarcely studied. ZnO crystallizes in the wurtzite structure and, thus, there is a charge asymmetry along the polar [0001] direction that generates a spontaneous polarization parallel to [000-1] [3]. To overcome the detrimental effects of these electrostatic fields the growth along non-polar directions has been proposed.

In this work we analyze the chemical etching of ZnO films grown along the non polar [11-20] direction by aqueous solutions of HCl (Fig.1). To get further insight into the influence of ZnO wurtzite structure in the chemical reactivity of different crystallographic facets, the surface contact potential distribution has been study by means of Kelvin Probe Microscopy (KPM) [4]. This charge sensitive technique allows to unambiguously identifying the observed facets and correlates their polarity with the measured chemical etching. To correctly interpret the KPM images, special attention has been paid to separate the contributions of the macroscopic "bulk" polarization and the surface properties, which are usually mixed up. A complete picture of the structural and surface electronic properties has been established, showing that the chemical etching is governed by the oxygen surface dangling bonds rather than by the polarization-induced surface charges [5].

Referencias:

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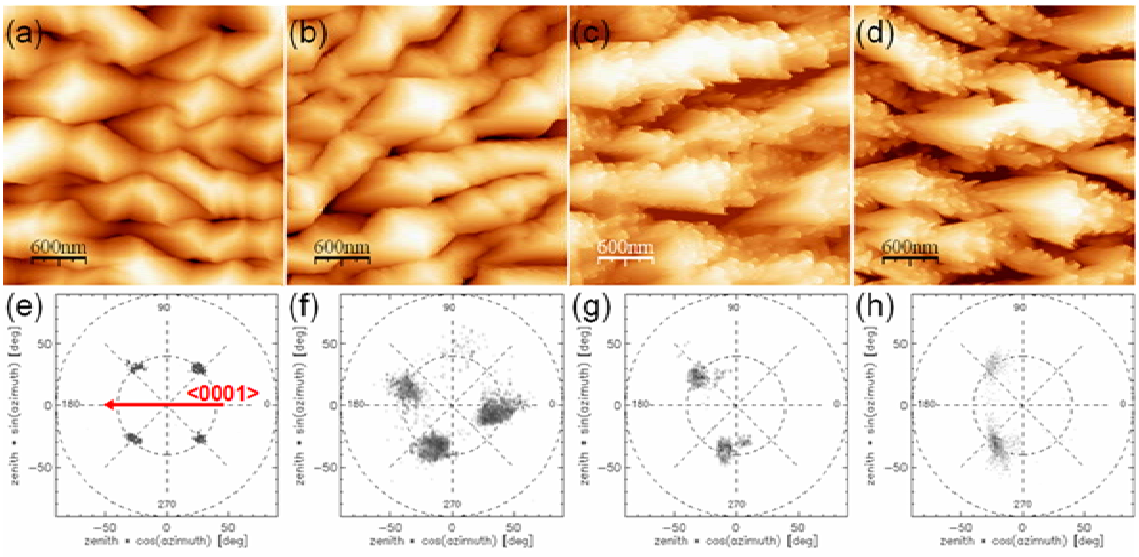

Figura 1: SFM topographic images and surface orientations histograms of as-grown (a and e) and HCl-etched *a*-plane ZnO thin films (b and f) 0.01M and 30s, (c and g) 0.1M and 5s, and (d and h) 0.1M and 10s.

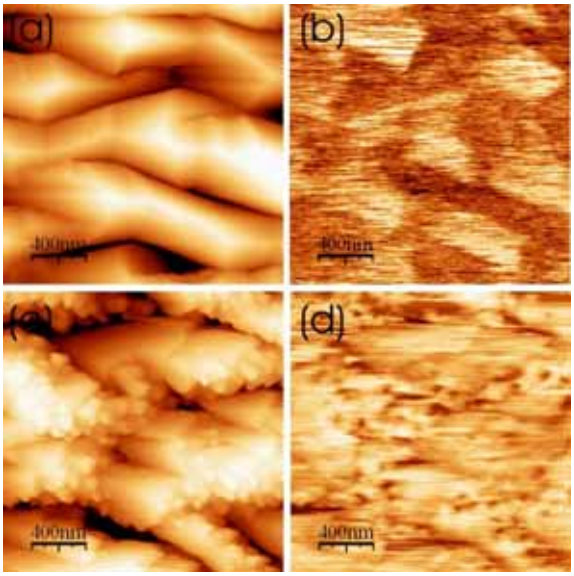

Figura 2: SFM topographic (a and c) and KPM images (b and d) of as-grown and HCl-etched (0.1M, 5s) *a*-plane ZnO thin films, respectively.