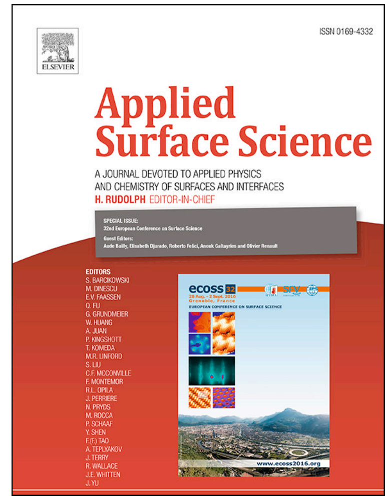

Full Length Article

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Influence of Ar^+ jet treatment and low substrate temperature on the solid-state dewetting of gold films

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Abstract
This paper looks at how solid-state dewetting of gold films is influenced by two particular substrate factors: an intense Ar^+ jet treatment of the substrate just before the gold deposition or a low substrate temperature during the gold deposition. This experimental study was conducted on three types of substrate - glass, silicon with a native oxide layer and mica. For each of these substrates we prepared three samples: a reference sample, an Ar^+ treated sample and a cryo-sample. The results are presented in terms of atomic force microscopy images which were taken at every step of each sample preparation. For the reference sample and the Ar^+ treated sample the solid-state dewetting will induce a pattern of islands which is rather homogeneous over the sample area, with larger and more isolated islands for the Ar^+ treated sample, these last ones also exhibiting a more pronounced tendency of crystallization. For the cryo-sample the solid-state dewetting pattern is of a different type, being much more complex and rather inhomogeneous over the sample area.

Keywords: solid-state dewetting, gold films, Ar^+ jet treatment, cold substrate

1. Introduction

Solid-state dewetting is a thermally driven process which can act on a uniformly deposited thin film to cause its retraction from some areas of the substrate and coagulate into islands of various shapes, sizes and states of crystallization. This film restructuring phenomenon will take place at a sufficiently elevated temperature, when the film's atoms will acquire a sufficiently high mobility to migrate on the substrate surface although this temperature is often found to be well below that of the melting point of the film's bulk material. Solid-state dewetting is a capillary effect [1-3], where the film's atoms cohesion forces become larger than the adhesion forces to the substrate as thermal treatment is applied to the film. This phenomenon can be sometimes undesired, causing the formation of residual droplets and other coating defects. On the other hand, solid-state dewetting can also be a useful phenomenon because of potential application to obtain nano-structured surfaces and devices. For example template solid-state dewetting of single-crystal films has been shown to be used to produce regular patterns of various shapes [4-14]. Another use of solid-state dewetting is that of an instrument for fabricating nano-particle arrays [15-19] which can be used in electronic, chemical and biological sensing or in photonic and nonlinear optical devices. In Ruffino et al. recent work [20], the controlled dewetting process of thin metal films on surfaces is reviewed as a patterning and nano-fabrication method for metal-based nano-composites. So