

Nanostructure and superhydrophobicity of thin films prepared ablating titanium in mixed argon/nitrogen atmospheres

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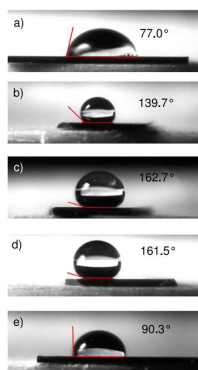
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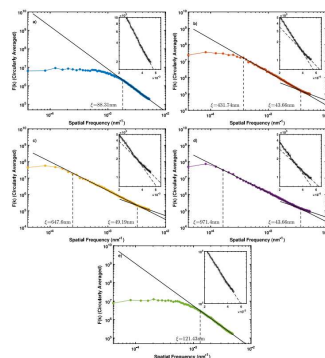
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The deposition of titanium oxynitride (TiO_xN_y) thin films via pulsed laser ablation in controlled argon and nitrogen atmospheres offers an excellent opportunity to tailor the film surface properties. Here we report on how varying the Ar: N_2 ratio affects the morphology and hydrophobicity of the obtained surfaces. Films were grown at a total ambient pressure of 40 Pa, while changing the Ar: N_2 partial pressure ratio between 0 and 1. The micro-structural properties of the film surfaces were investigated by both SEM and AFM microscopies. Structural analysis revealed that in pure Ar or N_2 environments spherical nanoparticles (NPs) form, whereas hierarchical dual-scale "cauliflower-like" structures emerge in Ar: N_2 mixed atmospheres. These morphologies resulted in contact angles with waater exceeding 150° , characteristic of superhydrophobic surfaces. Using Fourier transform and multifractal analysis we confirmed the role of hierarchical nanostructures in achieving such properties. We hypothesize that the presence of Ar in the gas mixture affects the plasma expansion dynamics favoring NP formation. In fact, while an atmosphere of N_2 molecules does not lead to the formation of the above structures, both chemically reactive N_2 and heavy Ar atoms, which bias the plasma expansion dynamics, jointly play to synthesize the observed structures.



Contact angle images for a water droplet on films with (a) Ar: N_2 =0:100; (b) Ar: N_2 =20:80; (c) Ar: N_2 =50:50; (d) Ar: N_2 =80:20; (e) Ar: N_2 =100:0.



Plots of the circularly averaged FT spectra for the investigated samples: the intensity of the frequency components is plotted against the spatial frequency (nm^{-1}). The correlation length (ξ) of the surface, which corresponds to the frequency (k) that separates different regimes are reported