Electronic Supplementary Material (ESI) for Materials Advances.

Optical and electronic properties of transparent conducting Ta:TiO_2 thin and ultra-thin films: effect of doping and thickness

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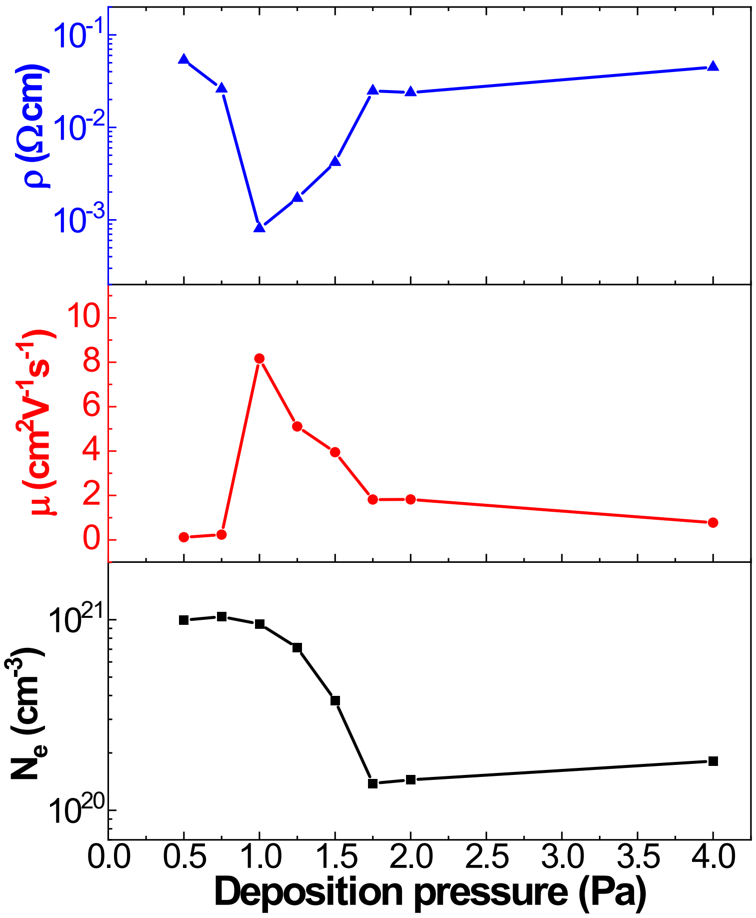

Figure S1 - Resistivity (ρ), charge carrier density (N_e) and mobility (μ) as a function of background oxygen pressure (P) during deposition of Ta(5%):TiO_2 films thick 200 nm.

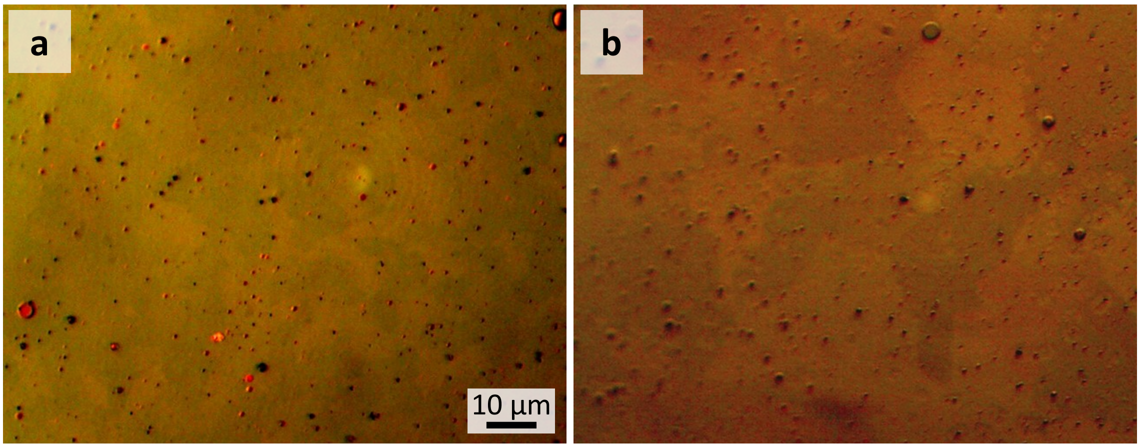

Figure S2 - Optical microscope images of surfaces of 200 nm-thick vacuum-annealed (a) Ta(5%):TiO_2 and (b) Ta(10%):TiO_2. All samples were deposited on glass substrate.

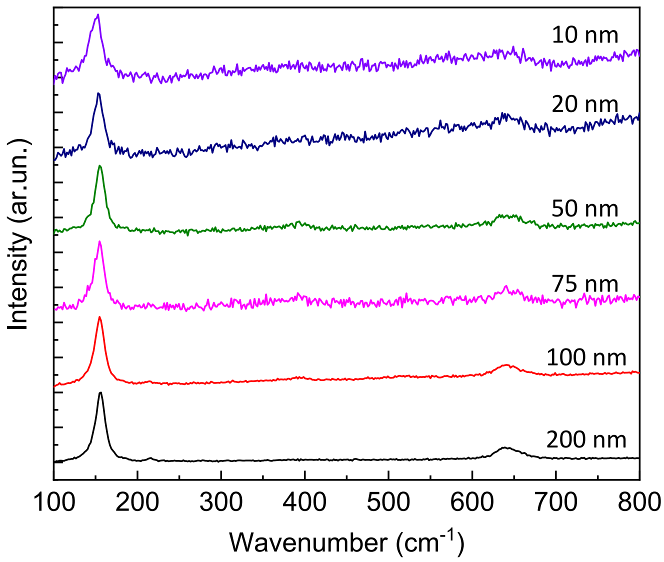

Figure S3 - Raman spectra of Ta(10%):TiO_2 films at different thickness, i.e. from 10 up to 200 nm.

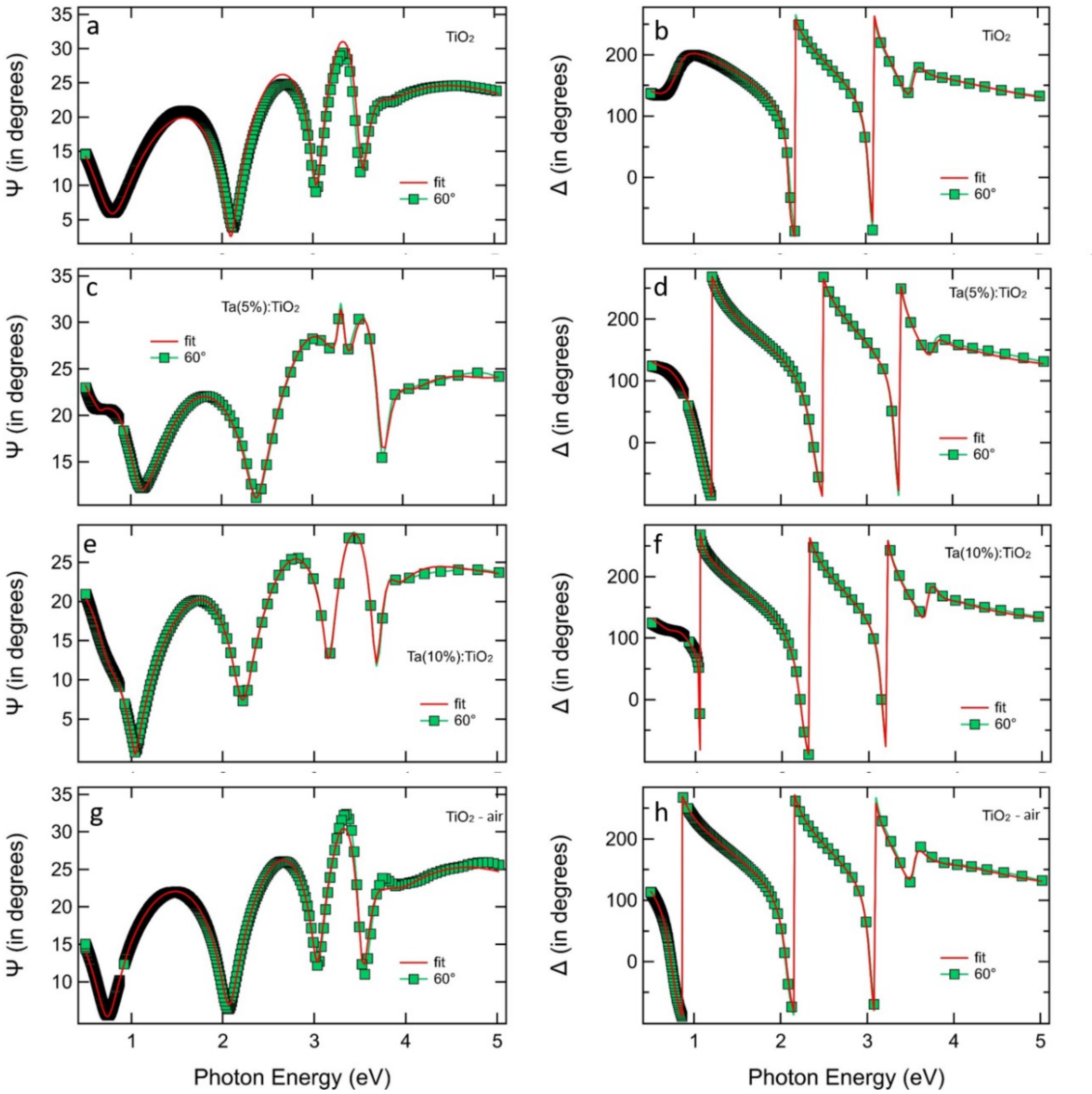

Figure S4 - Ellipsometric angles Ψ (left) and Δ (right) as a function of photon energy for (a, b) vacuum-annealed TiO_2, (c, d) Ta(5%):TiO_2, (e, f) Ta(10%):TiO_2 and (g, h) air-annealed TiO_2 films thick 200 nm and grown on Si substrates, acquired with incident angle of 60°. Squares and lines represent experimental data and theoretical fit, respectively.

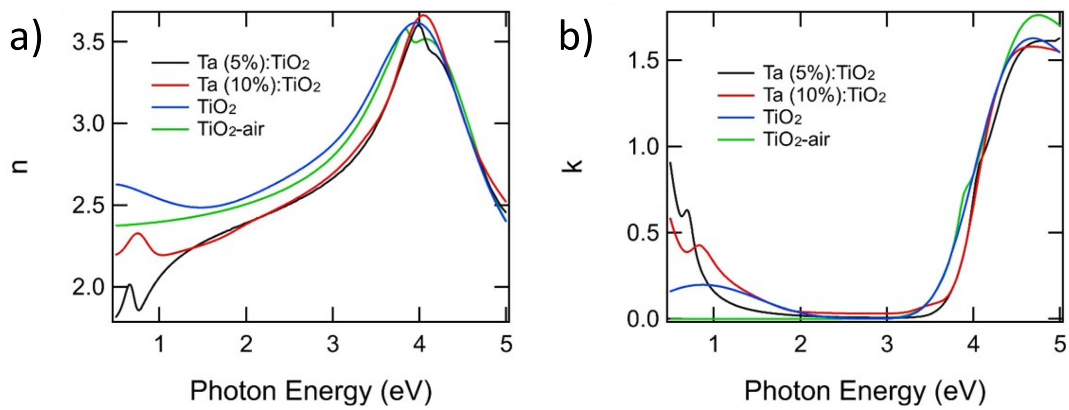

Figure S5 - (a) Refractive index (n) and (b) extinction coefficient (k) of the Ta:TiO_2 films as extracted from the dielectric function. Measurements on vacuum- and air-annealed TiO_2 films are reported for reference.

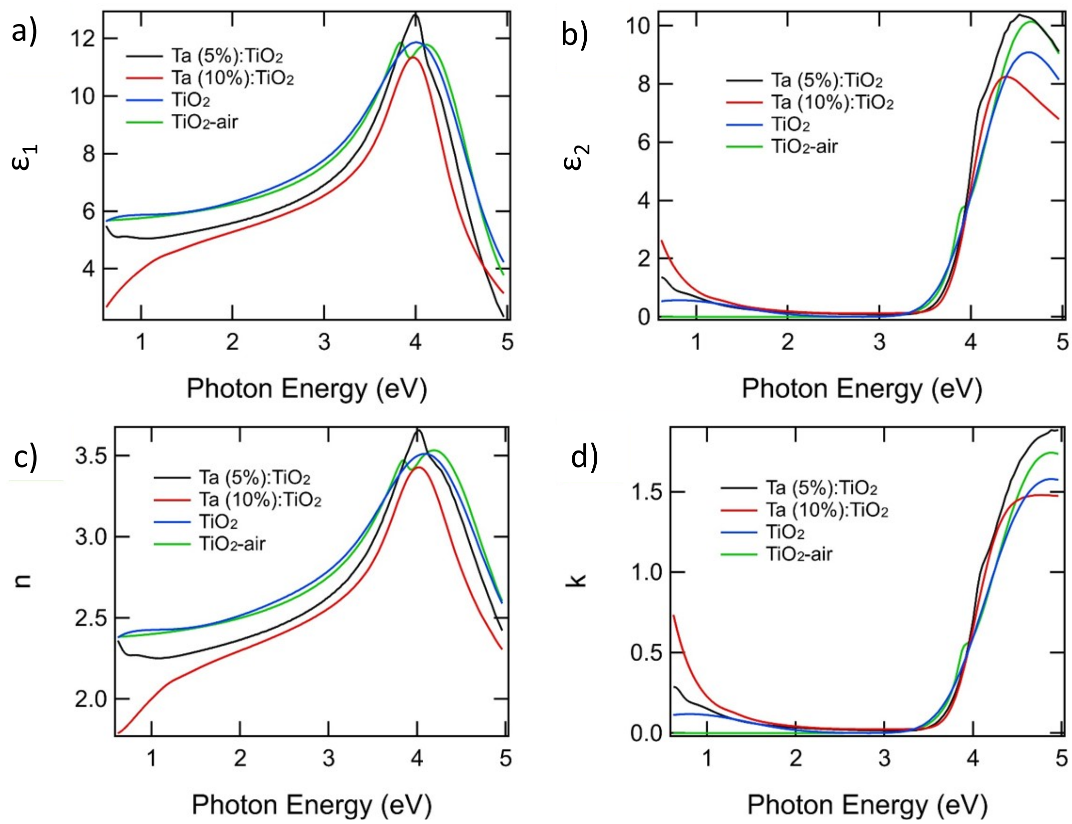

Figure S6 - (a) Real and (b) imaginary parts of the dielectric constant of Ta:TiO_2 films of different doping levels (5,10% at.), grown on soda-lime substrates, as extracted from the modelling of their transmission measurements by applying in the model the optical constants of Fig. 5. (c) Refractive index n and (d) extinction coefficient k of the Ta:TiO_2 films as extracted from the dielectric function. Measurements on vacuum- and air-annealed TiO_2 films (blue and green lines respectively) are reported for reference.

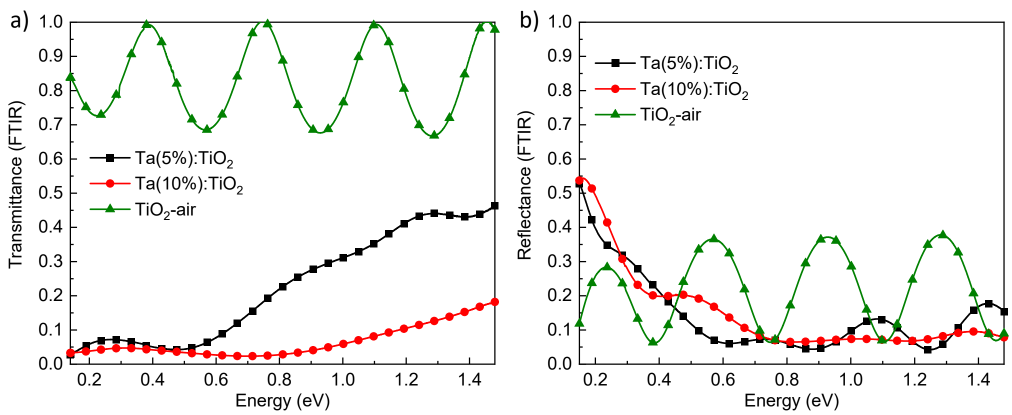

Figure S7 - (a) Transmittance and (b) reflectance spectra collected by Fourier Transform Infrared Spectroscopy (FTIR) of Ta(5%):TiO_2, Ta(10%):TiO_2 and air-annealed TiO_2 (TiO_2-air) films thick 670 nm and grown on CaF_2 substrate.