

Structural properties of B-doped VO₂ epitaxial films

Aude Bailly, Pierre Bouvier, Stéphane Grenier, Michael Gaudin, Aline Y. Ramos, Laëtizia Laversenne

Université Grenoble Alpes, CNRS, Institut Néel, 38000 Grenoble, France

aude.bailly@neel.cnrs.fr

Vanadium dioxide (VO₂) is known to exhibit a reversible insulator-to-metal transition at *ca.* 68°C. This transition is characterized by a drastic change of the electrical, optical and structural properties. These thermally-driven changes make VO₂ very attractive for various applications, such as thermochromic windows, passive radiators and so on [1]. One of the key points for relevant applied solutions is to be able to tailor the VO₂ properties, especially to decrease its transition temperature, while keeping a good resistivity contrast. Strain engineering and chemical doping are therefore two common routes to tune the material's properties [2, 3].

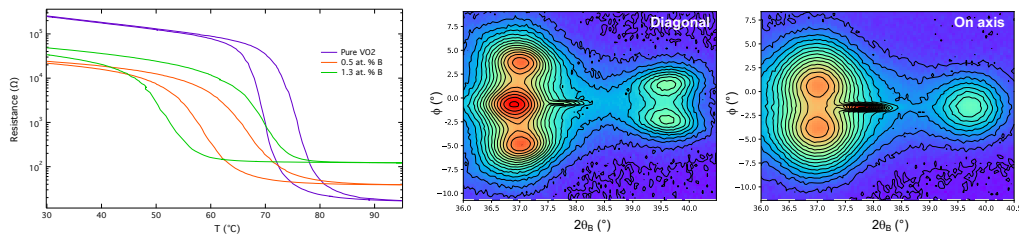


Fig. 1 (Left) Resistance recorded upon temperature cycling. // In plane reciprocal space maps obtained for a pure (middle) and a boron-doped (right) VO₂ sample.

In this work, 100 nm-thick pure and boron-doped VO₂ films grown on Al₂O₃(0001) by Pulsed Laser Deposition were studied during their insulator-to-metal transition [4]. We implemented complementary techniques (X-ray diffraction, Raman and Fourier Transform Infrared Spectroscopies) to highlight the impact of boron on their structural and physical properties. Increasing the boron amount tends to decrease the transition temperature, but the hysteresis quality is also substantially affected in the case of the most doped sample (Fig. 1, left). In this latter case, Raman spectroscopy evidenced the appearance of a M2-like semi-insulating phase, slightly before the transition temperature. X-ray diffraction gave the preferential growth directions for each sample, but more interestingly revealed two peculiar in-plane surface epitaxial relationships (maps of Fig. 1); one of these was already observed for a thicker VO₂ film [5]. A switch from the diagonal to the on-axis setting is shown to occur when the boron concentration increases.

References

- [1] Y. Ke, S. Wang, G. Liu *et al.*, *Small* 14, 1802025 (2018).
- [2] Y. Muraoka and Z. Hiroi, *Appl. Phys. Lett.* 80, 583 (2002).
- [3] W. Burkhardt, T. Christmann, B. K. Meyer *et al.*, *Thin Solid Films* 345, 229 (1999).
- [4] A. Bailly, P. Bouvier, S. Grenier *et al.*, submitted to *Appl. Surf. Sci.*
- [5] A. Bailly, S. Grenier, M. M. Villamayor *et al.*, *J. Appl. Phys.* 126, 165306 (2019).