Interface barriers at Metal – TiO_2 contacts

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Metal-oxides combine a unique ensemble of properties presenting great potential to meet the diverse requirements of modern electronics and in particular of brain-inspired applications[1]. Among others, TiO_2 is without a doubt one of the most celebrated materials. The ability of TiO_2 to obtain different microstructures (i.e. amorphous, rutile etc.) and thus a plethora of electronic properties that can be determined/controlled by the fabrication[2] and/or biasing[3] conditions augmented its use in practical applications, such as memristors[4], TFTs[5] and sensors[6]. Notwithstanding the importance of the active layer, identifying appropriate metal contacts and deciphering their interfacial role is also of paramount importance to a device's electrical behaviour[7,8]. This paper aims to present a detailed quantitative electrical characterization study of Metal-TiO_2 interface characteristics.

The study is performed by recording the current-voltage (I-V) characteristics of Metal-TiO_2-Metal stacks at different temperatures (Fig. 1(a)), through appropriate modelling and analysis that includes field and temperature dependent signature plots (Fig. 1(b)). The results revealed the major role of the metal electronegativity and of the interface states on the formation of the interface barriers (Fig. 1(c) and 1(d)). The study also came across an unexpected observation where the common bottom electrode interfaces are found to be not identical but influenced by the top electrode material. Overall, this work provides a useful database for selecting appropriate electrode materials in TiO_2 based devices, offering new insights on the role of electrodes on metal-oxide electronic applications.

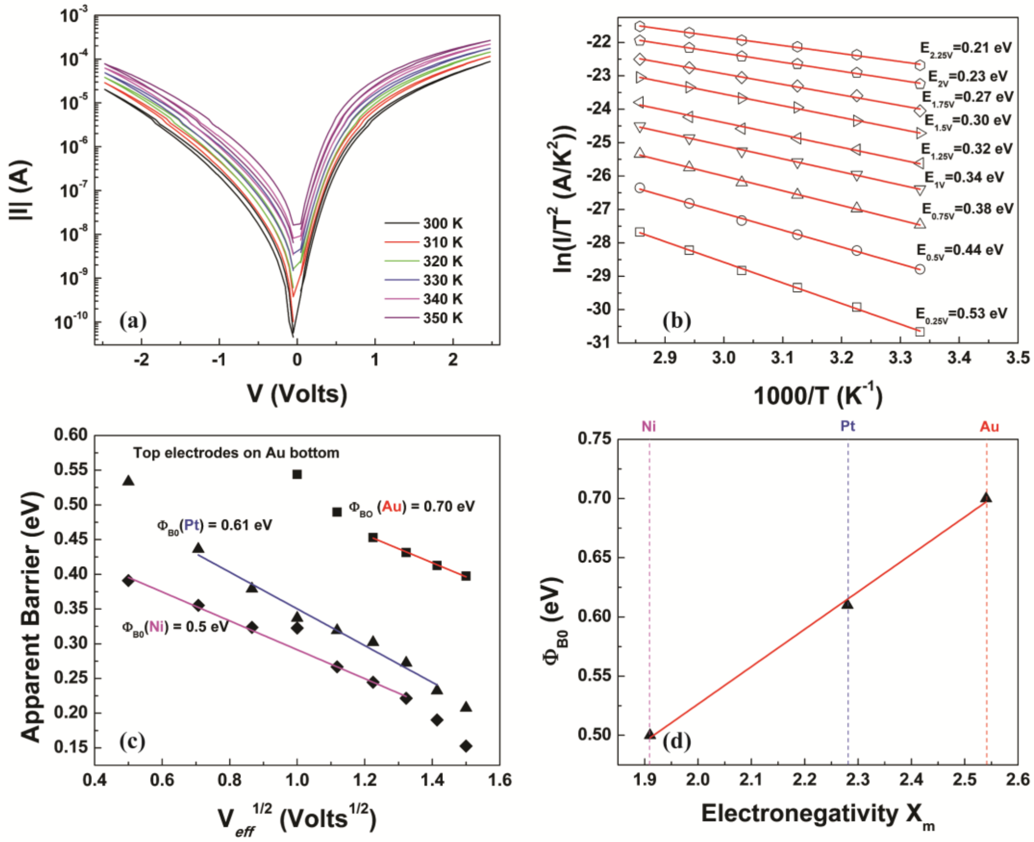

Figure 1: Analysis of the I-Vs, recorded at different temperatures (a), allowed the extraction of signature plots (b) that lead to interface barriers calculations (c). These depend on the electronegativity of the metal electrode (d.)

References

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