Potential distribution at Pt/SrTiO$_3$ interface determined by X-ray photoelectron spectroscopy

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Metal/SrTiO$_3$ junctions show unique electric characteristics, such as contact at Pt and heavily doped n-type SrTiO$_3$ shows large hysteresis in its current-voltage ($I$-$V$) relationships [1]. It is evident that those properties are, in principle, understood by the picture of Schottky junction but mechanism of the hysteresis is still unclear, although there are many attempts to develop non-volatile memory cells utilizing the hysteresis in $I$-$V$ curve.

One of the difficulties in studying metal/SrTiO$_3$ junctions is that capacitance-voltage ($C$–$V$) measurement, the most fundamental technique for evaluation of physical parameters at Schottky junctions, is not able to be analyzed using conventional Schottky junction theories. A possible way for us to understand the $I$–$V$ and $C$–$V$ curve of the metal/SrTiO$_3$ junctions is that we assume electric field dependence of dielectric permittivity in SrTiO$_3$. With this assumption, we could fit the observed $I$–$V$ and $C$–$V$ curves to a phenomenological model [2].

In this study, we performed hard-x-ray photoelectron spectroscopy (HAXPES) [3] for evaluation of potential distribution at the metal/SrTiO$_3$ junctions. In order to verify our model assuming the field dependent electric permittivity, we measured temperature variation of HAXPES profile at T=50-300K.