Copper substrate oriented with (111) crystal planes for graphene growth

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Abstract

In this study, we aimed to fabricate a substrate featuring highly textured Cu(111) crystal planes on its top layer, utilizing a flexible template tape with a layered structure of $MgO/Y_2O_3/Al_2O_3$/Stainless steel. The MgO layer was prepared using the Ion Beam Assisted Deposition (IBAD) method [1]. Initially, a Nickel (Ni) film was deposited onto the IBAD-aligned MgO film, which has a (001) crystal plane orientation, via DC sputtering. This Ni layer was then converted into a NiO layer through a surface oxidation heat treatment [2] conducted between 300 and 500°C. Subsequently, a Cu film was deposited onto the NiO layer by DC sputtering. Figure 1 illustrates the schematic layout of our substrate's final architecture, while Figure 2 presents the EBSD map of the Ni layer (a) and the 2-theta X-ray diffraction pattern of the final Cu layer (b). The EBSD analysis indicated that the Ni film maintained a singular (001) crystal orientation, aligning parallel to the MgO layer and suggesting growth to the single-crystal level. Results from section (b) of Figure 2 demonstrate that the NiO layer, formed through the oxidative annealing of the Ni thin film, developed a (111) orientation. Subsequently, the deposited Cu thin film exhibited epitaxial growth while maintaining the (111) crystal orientation. A more comprehensive presentation of these results will be provided at the upcoming conference.

References

[1] Paul N. Arendt and Stephen R. Foltyn, Material Matter, Vol.29 (2004) 543-544.
[2] T. Watanabe, K. Wada, Y. Ohashi, M. Ozaki, K. Yamamoto, T. Maeda and I. Hirabayashi, Physca C: Superconductivity, Vol.378-381 (2002) 911-916

Figures

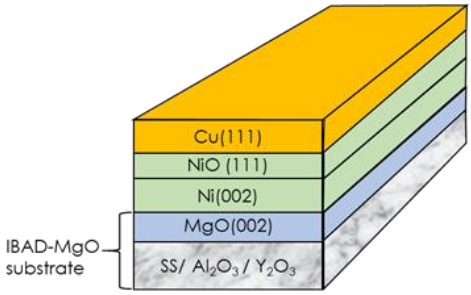

Figure 1: Schematic layout of architecturte of Cu substrate with textured crystal planes..

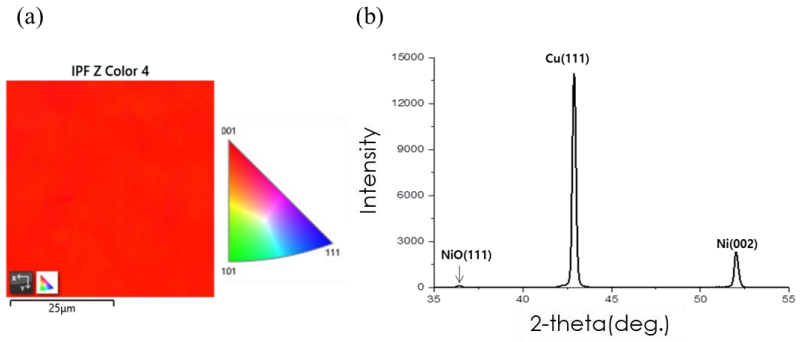

Figure 2: EBSD orientation map (a) of Ni film layer and 2-theta XRD pattern (b) of Cu film layer.