

Spectroscopic Investigation of Bandwidth Control Effects on the Mott-Hubbard State in Epitaxial RVO_3 ($R = La, Pr, Y$) Thin Films

Shivank Kalia¹, Varun Ranade^{2,#}, Keun Hwa Chae², Ram Janay Choudhary³, Rajesh Kumar¹, Ravi Kumar^{4,*}

¹ Department of Physics and Photonics Science, National Institute of Technology, Hamirpur, India

² Advanced Analysis Center, Korea Institute of Science and Technology, Seoul, Republic of Korea

[#]Present address: School of Physics, Trinity College Dublin, College Green, Dublin 2, Ireland

³ UGC-DAE Consortium for Scientific Research, University Campus, Khandwa Road, Indore, India

⁴ Department of Materials Science and Engineering, National Institute of Technology, Hamirpur, India

*Corresponding Author Email: ranade65@nith.ac.in

Supplementary Data:

1. Resonant Photoemission Spectroscopy (RPES) Analysis

Fig. S(1-3) depicts the energy distribution curves (EDCs) of the epitaxial RVO_3 film for photon energy varying from 40 to 60 eV. From the EDCs, it is clearly observed that the intensity of the feature A at BE = 1.3 eV for $LaVO_3$, 1.4 eV for $PrVO_3$ and 1.6 eV for YVO_3 increases with the photon energy, and it reaches maximum at about 52 eV and finally decreases with the increase in the photon energy.

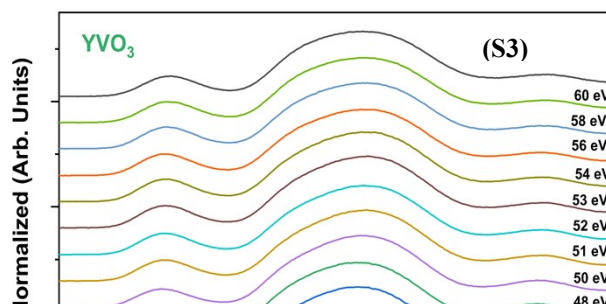
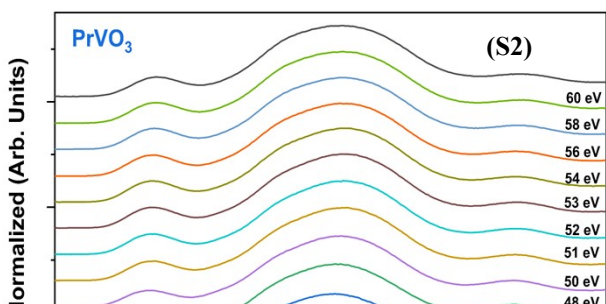
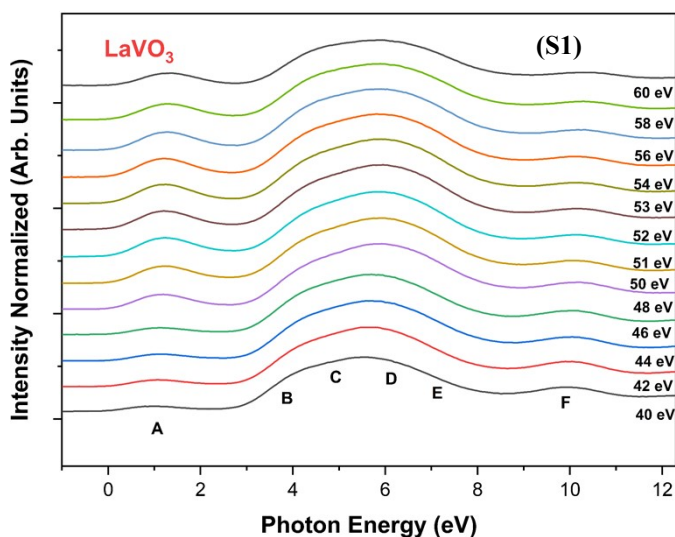
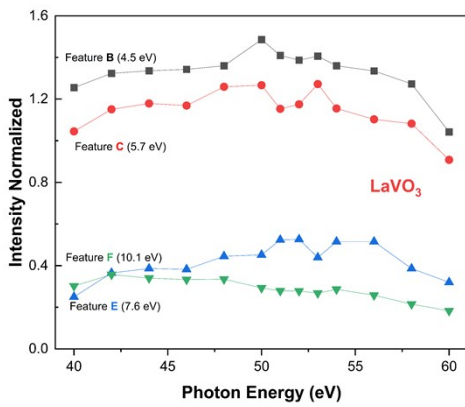
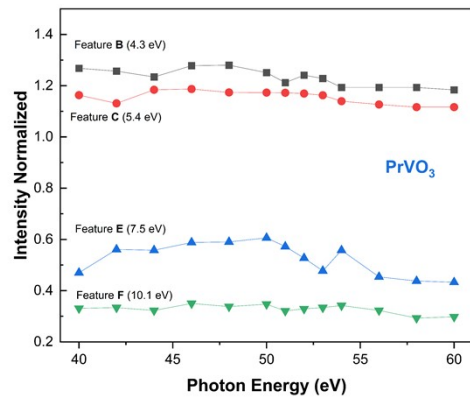


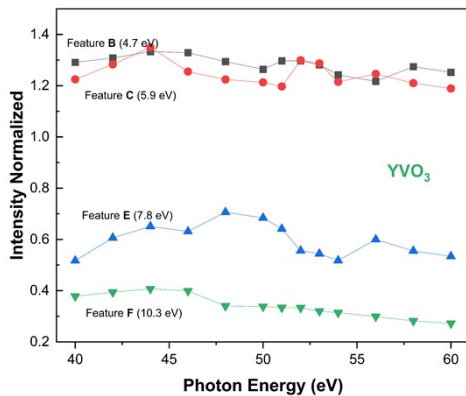
Fig. Energy distribution curves obtained for the (S1) LaVO_3 , (S2) PrVO_3 , and (S3) YVO_3 thin films at 300 K for the photon energies between 40 and 60 eV. CIS plots of features B, C, E and F for LaVO_3 thin films is shown in Fig. S(4-6).



(S4)



(S5)



(S6)

Fig. Constant initial state (CIS) spectra of features B,C,E and F in the valence band of the (S4) LaVO_3 , (S5) PrVO_3 , and (S6) YVO_3 thin films at 300 K.

2. Atomic Force Microscopy Analysis

To ensure the surface quality required for surface-sensitive spectroscopic measurements (RPES and XAS), the surface morphology of the thin films was characterized using Agilent 5500 atomic force microscopy (AFM). Fig. S7 shows the representative topographical images of the LaVO_3 , PrVO_3 , and YVO_3 thin films. The root-mean-square (RMS) roughness values were determined to be approximately 9 Å for LaVO_3 , 2 Å for PrVO_3 , and 3 Å for YVO_3 . These low roughness values (all below 1 nm) confirm the high quality of the epitaxial growth and ensure that the photoemission spectra are representative of the intrinsic material properties rather than surface roughness effects.

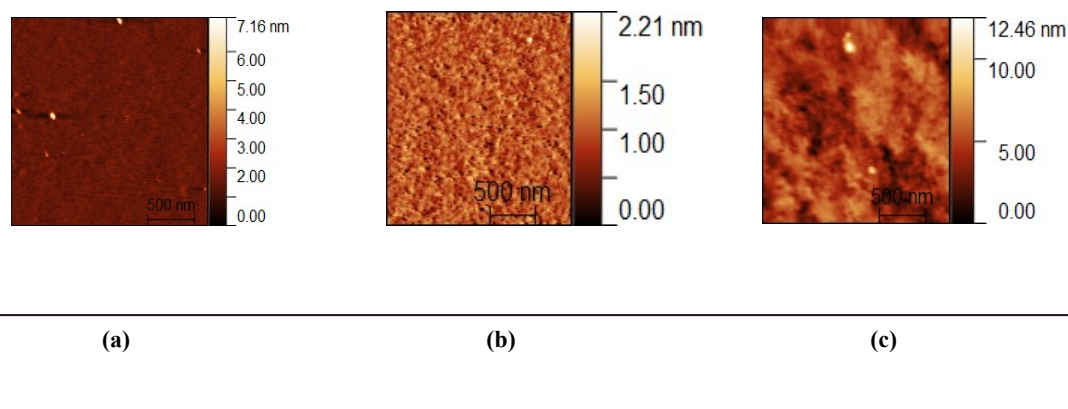


Fig. S7. $2\ \mu\text{m} \times 2\ \mu\text{m}$ AFM image of (a) LaVO_3 , (b) PrVO_3 and (c) YVO_3 films deposited on LaAlO_3 substrate.