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Electronic Supplementary Information

Two-Step Epitaxial Growth of NbON (100) Thin Films on Rutile-Type TiO_2 (101) Substrates and Reduction of Residual Carrier Concentration by RF Reactive Sputtering

Ryosuke Kikuchi*, Toru Nakamura, Yasushi Kaneko and Kazuhito Hato
Technology Innovation Division, Panasonic Corporation, Osaka, 570-8501, Japan

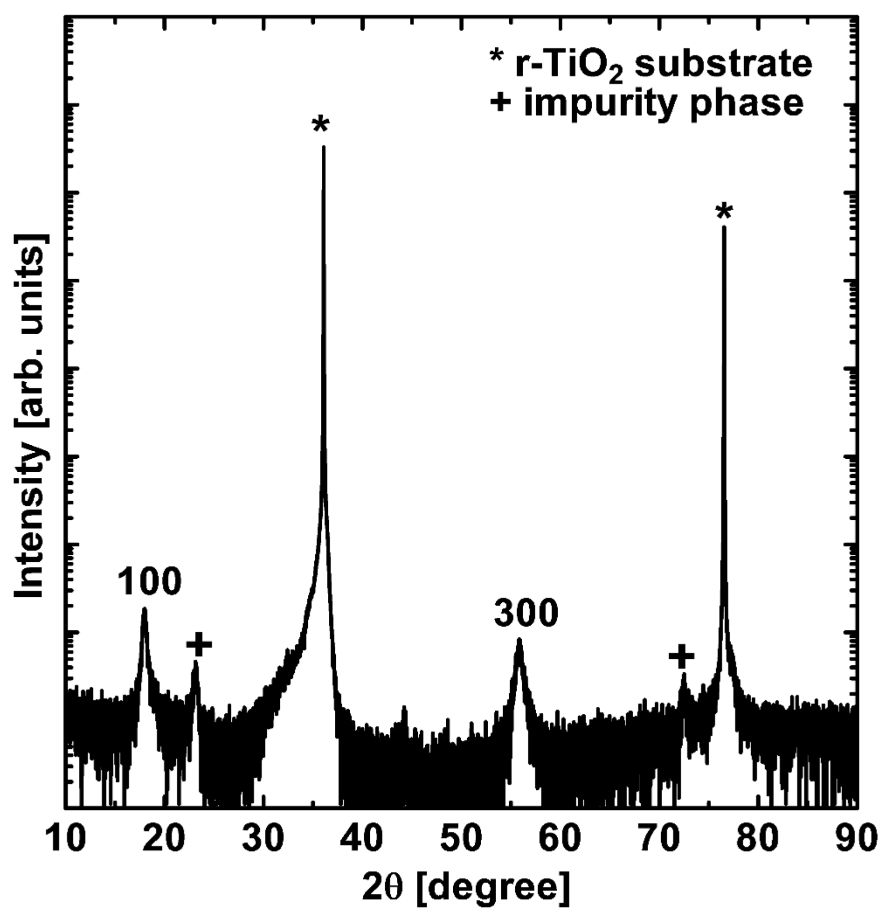

Fig. S1 2θ/ω scan XRD profile of 1-step NbON film grown on r-TiO_2 (101) substrates. In this sample, $f_{O2}/[f_{O2}+f_{N2}]$ was set at 0.034 and the substrate temperature was 500°C. This profile shows weak peaks at h00 reflections and impurity peaks, suggesting that the orientation and crystalline quality had declined.

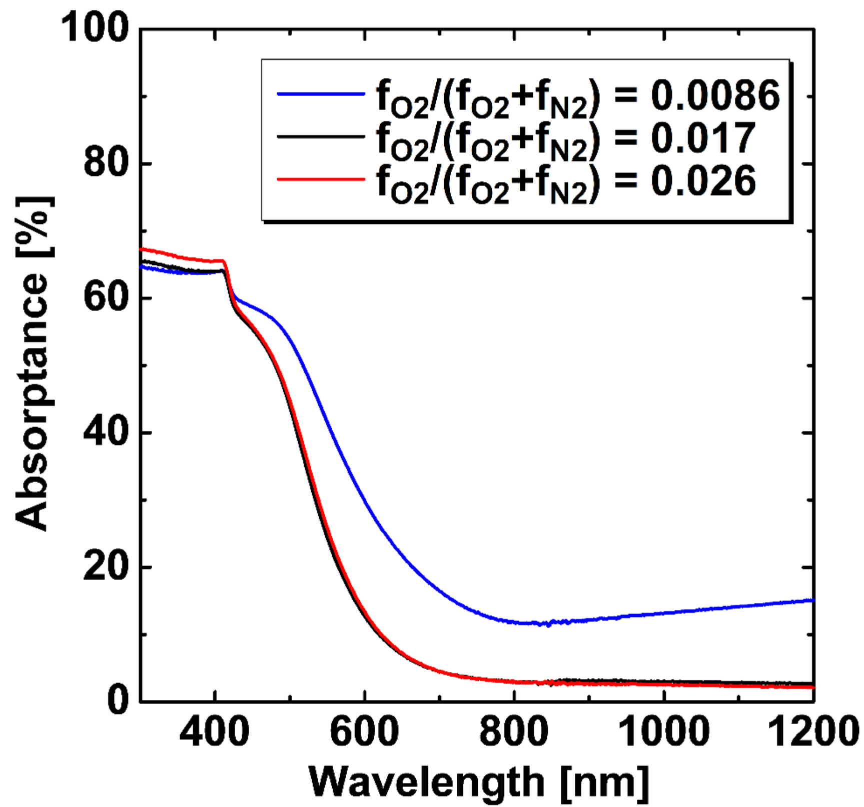

Fig. S2 UV-Vis absorption spectra of 2-step NbON films grown on r-TiO_2 (101) substrates. In the 2-step layer of these samples, $f_{O2}/[f_{O2}+f_{N2}]$ was set at 0.0086, 0.017, and 0.026, and the substrate temperature was 500°C. Under O-poor growth condition ($f_{O2}/[f_{O2}+f_{N2}]$ = 0.0086), we observed broad in-gap absorption from 800 to 1200 nm possibly due to formation of reduced Nb states. Under intermediate($f_{O2}/[f_{O2}+f_{N2}]$ = 0.017) and O-rich growth condition ($f_{O2}/[f_{O2}+f_{N2}]$ = 0.026), the spectra showed clear absorption less than 600 nm corresponding to the band gap of NbON (2.1 eV).