Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Observation of Voltage Oscillations in VO_2 with Negative Differential Resistance DAE-JOON KANG, HYOUNG WOO YANG, GARAM BAE, Department of Physics, Sungkyunkwan University, Republic of Korea — Many strongly correlated electron systems exhibit complex nonlinear behaviors with electric fields. The origin of the electrical instabilities is closely related to a negative differential resistance (NDR). Here, we report electrical characteristics of two-terminal devices based on vanadium dioxide (VO_2) thin films fabricated on c-cut sapphire substrates, exhibiting NDR behavior in their I-V characteristics that may work as a voltage oscillator of high efficiency. We show that the NDR behavior can be better understood in the context of metal-insulator phase transition. Furthermore, we found that the source voltage and frequency affect greatly the NDR behaviors, which is indicated by an evident shift of oscillation voltage from 10 V to 1 V. Based on the experimental results, with the source voltage and the frequency systematically varied, the mechanism of the oscillation was found to be the ascribed to an alternate occurrence of an electric-field-induced resistance switching in the MIT of VO_2. We discuss herein, the origin and potential applications of NDR based devices in detail and investigated the voltage oscillation behaviors of VO_2 to elucidate the underlying physics of its metal insulator transition behavior.

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Date submitted: 13 Jan 2016 Electronic form version 1.4