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Atomic Layer Deposited Ta_2O_5/Al_2O_3, ZrO_2/Al_2O_3 and ZrO_2/Ta_2O_5 as Dual Dielectric MIIM Diodes for Rectenna Applications NASIR ALIMARDANI, JOHN F. CONLEY, School of EECS, Oregon State University, Corvallis, OR, STEPHEN KILPATRICK, MADAN DUBEY, U.S Army Research Laboratory, Adelphi, MD
— A rectenna is an integrated receiving antenna and diode that captures electromagnetic energy and converts it to DC power at high efficiency. Harvesting of energy in the infrared (IR) region requires rectification at ∼10 THz frequencies. Because of their high speed of operation, metal/insulator/metal tunnel diodes are a potential candidate for this application. The primary MIM diode requirements for rectenna applications include a highly nonlinear and asymmetrical current-voltage (I-V) characteristic with low "zero-bias" resistance. To meet these requirements, Ta_2O_5/Al_2O_3, ZrO_2/Al_2O_3, and ZrO_2/Ta_2O_5 nanolaminate stacks were deposited using atomic layer deposition (ALD) on Al and Pt electrodes to form MIIM structures. The use of dual dielectrics with different bandgaps and conduction band offsets improves asymmetry of the I-V response. Expected and measured I-V characteristics are compared as a function of insulator material, thickness, and gate metal.

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