# Optical and Electrical Characteristics of Fabricated Three-Layered Al/$Er_2O_3$/$Eu_2O_3$/$SiO_2$/n-Si/Al MOS Capacitors for Radiation Sensors


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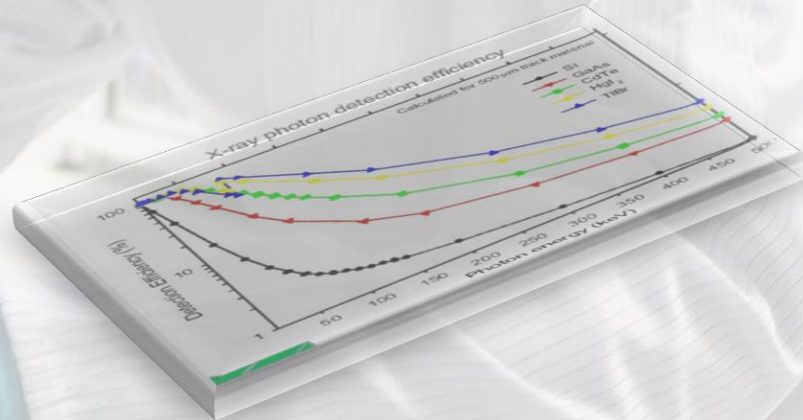



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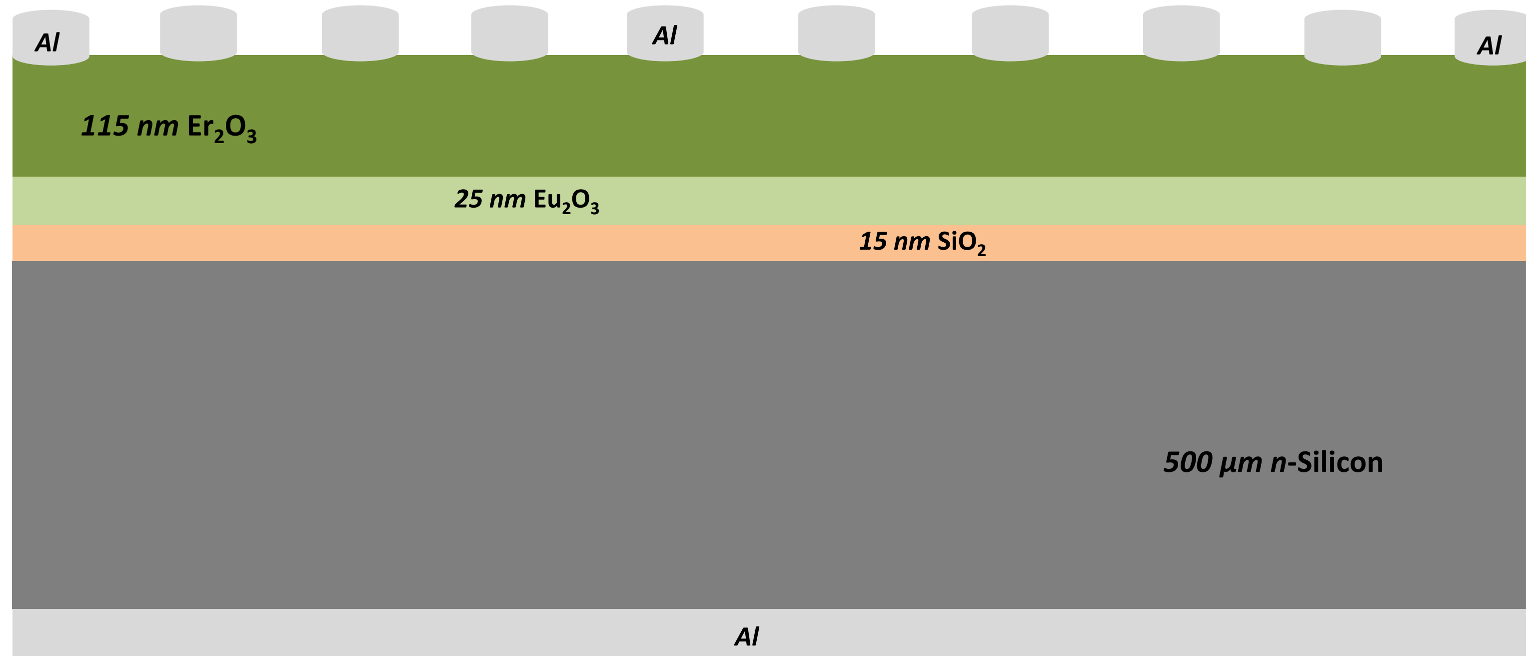
# INTRODUCTION

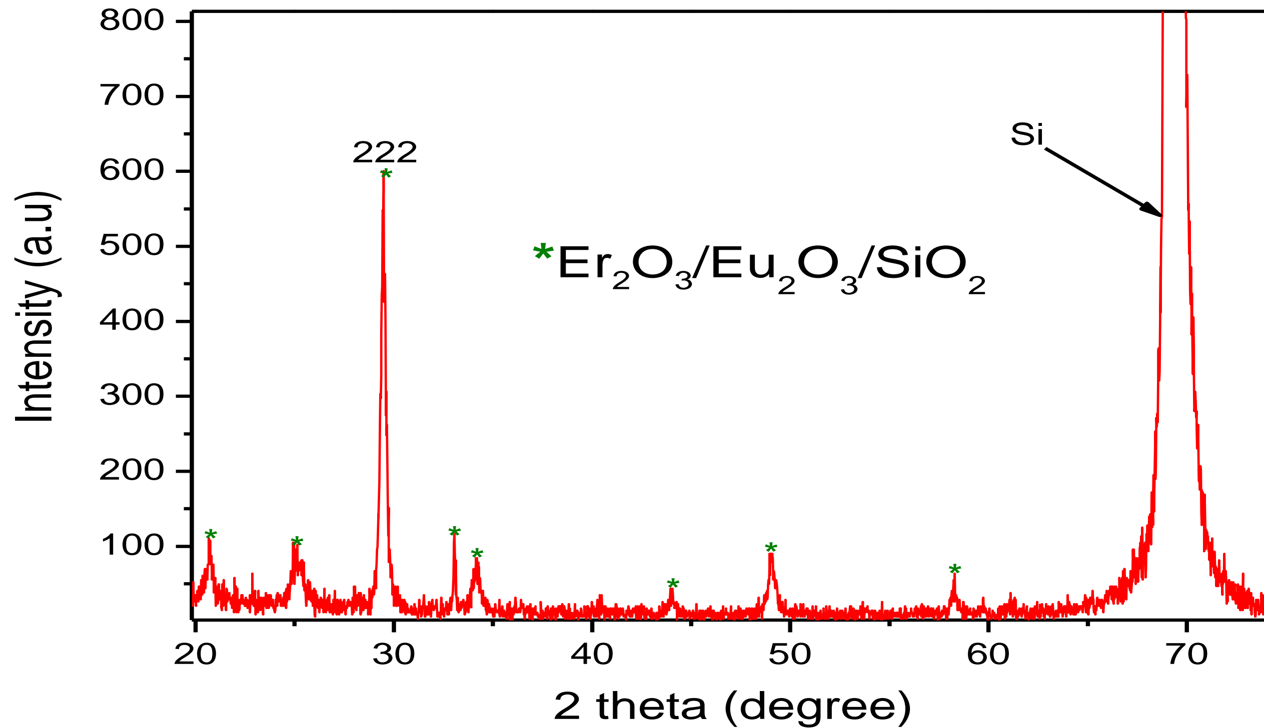
The aim of this work is to study, investigate and analyze the optical properties of the $Er_2O_3/Eu_2O_3/SiO_2$/n-Si thin films, particularly focusing on reflection, transmittance and absorption. And the electrical characteristics of the fabricated stacked gate oxide of 15 nm thick $SiO_2$, 25 nm thick $Eu_2O_3$ and 110 nm thick $Er_2O_3$, ($Al/Er_2O_3/Eu_2O_3/SiO_2$/n-Si/Al) MOS Capacitors having electrode areas of 0.01767 $cm^2$ grown on the n-Silicon substrate using thermal oxidation, electron beam evaporation and sputtering, respectively. In particular, Capacitance – Voltage, conductance – voltage, $G/w - V$, and series resistance $R_s$ are emphasized. Interfacial layers, which appeared to cause interfacial dipoles, are used to reduce the interface trap charge density and oxide tarp charge density, in order to improve the charge storage capacity of the device. Series resistance affects the characteristics of the $C - V$ and conductance curves essentially in inversion and accumulation modes.

# EXPERIMENTAL DETAILS

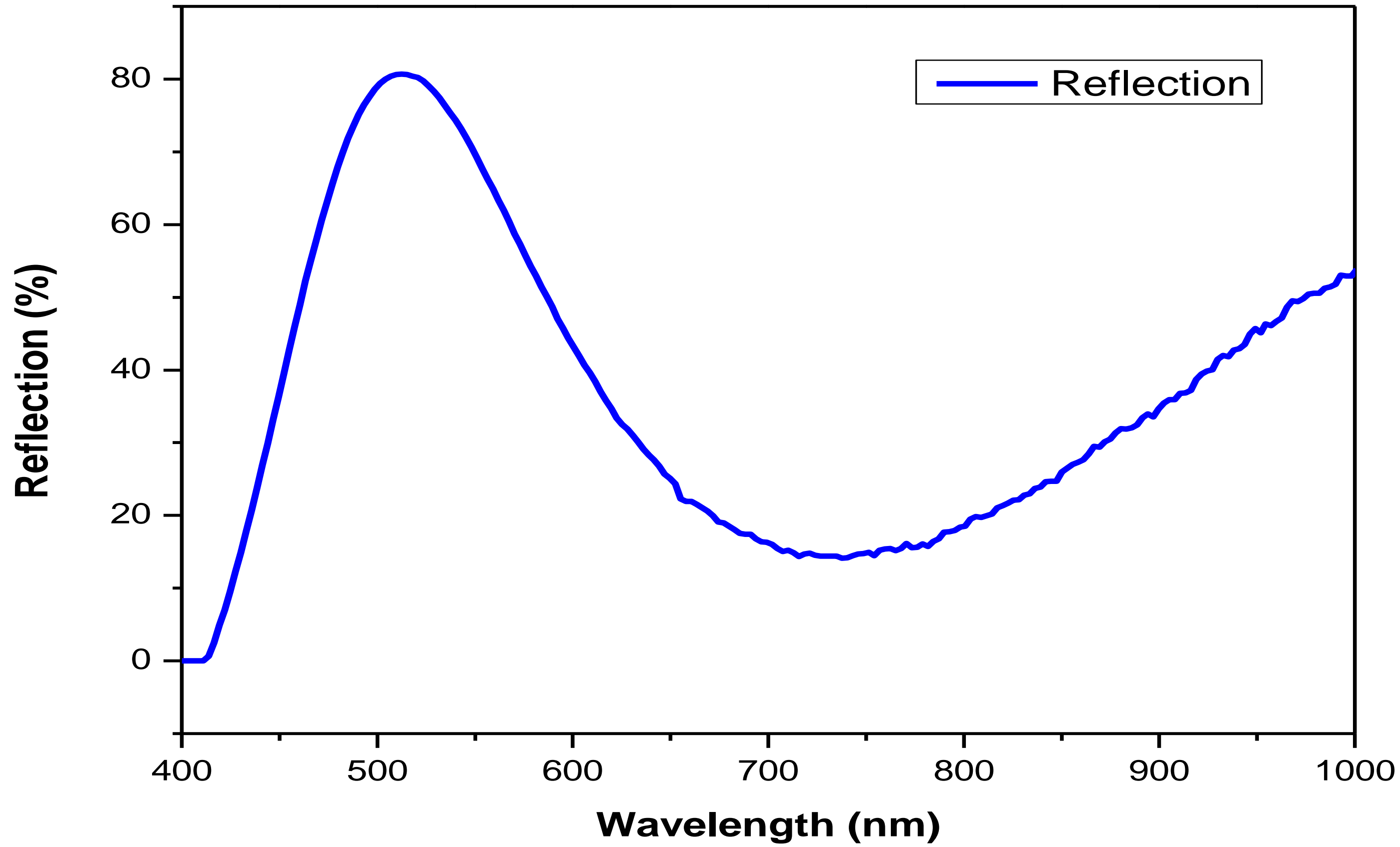



Schematic Structure of the Fabricated Al/$Er_2O_3$/$Eu_2O_3$/$SiO_2$/*n*-Si/Al MOS Capacitors.

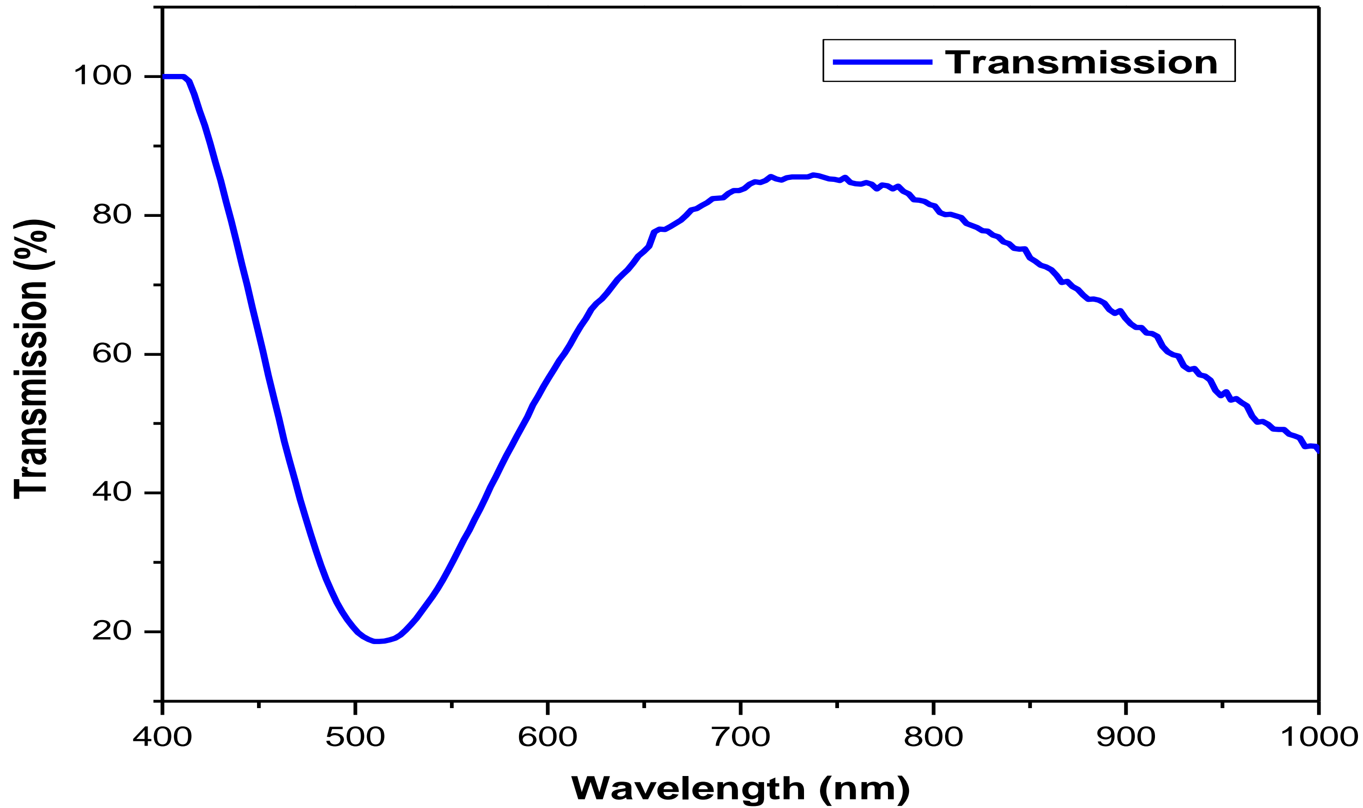
# RESULTS AND DISCUSSIONS



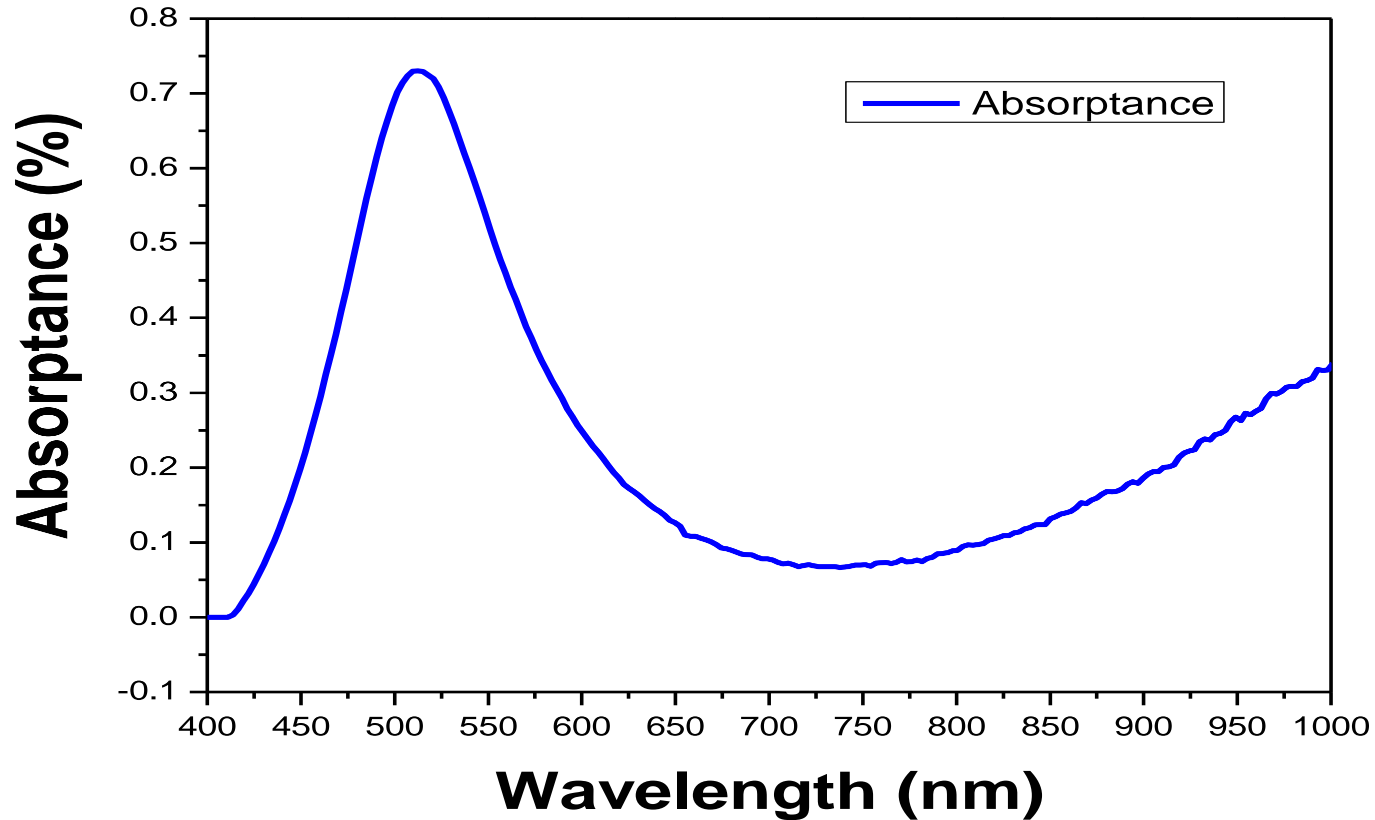

X-ray Diffraction Pattern of $Er_2O_3/Eu_2O_3/SiO_2$ Thin Films Grown on n-Silicon Substrate.



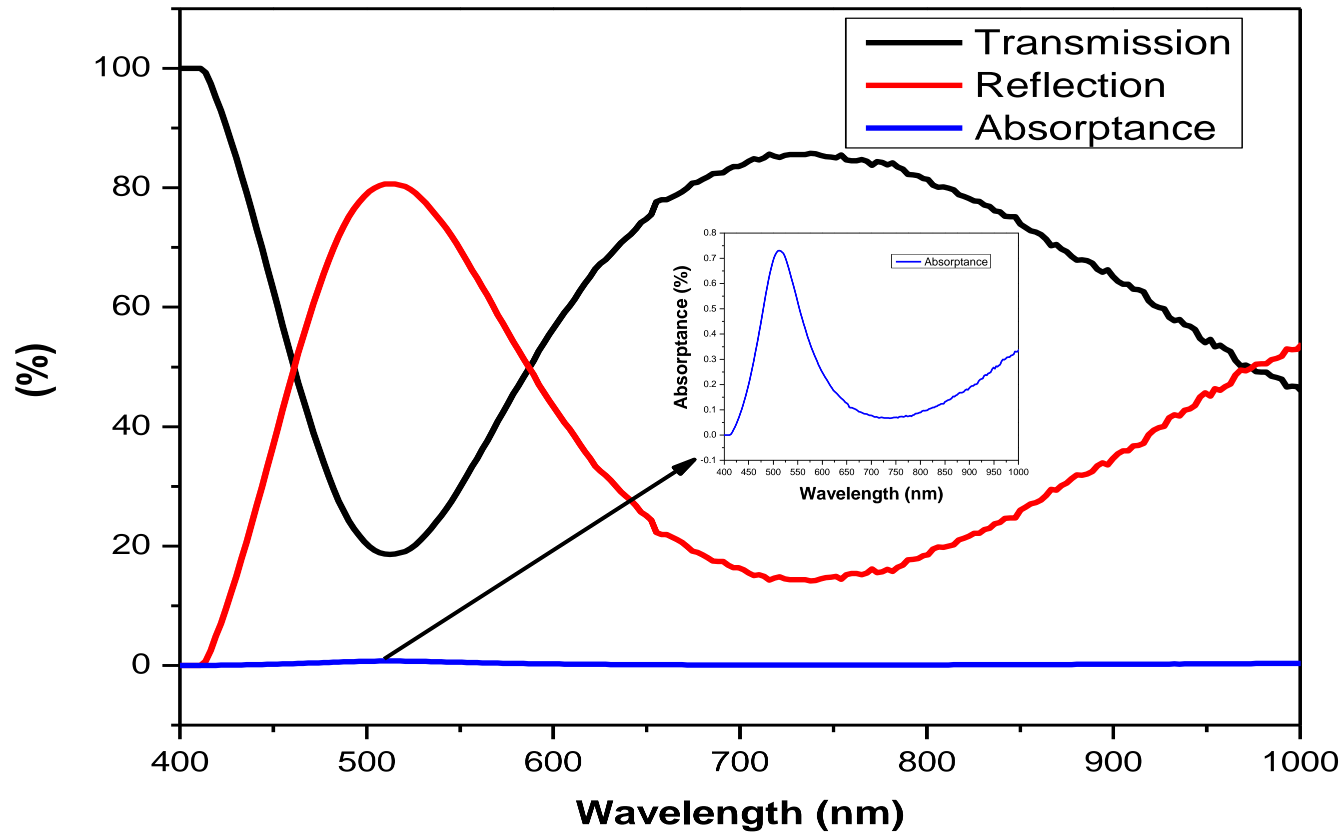

Reflection spectra as a function of wavelength for $Er_2O_3/Eu_2O_3/SiO_2$ Thin Films Grown on n-Silicon Substrate.



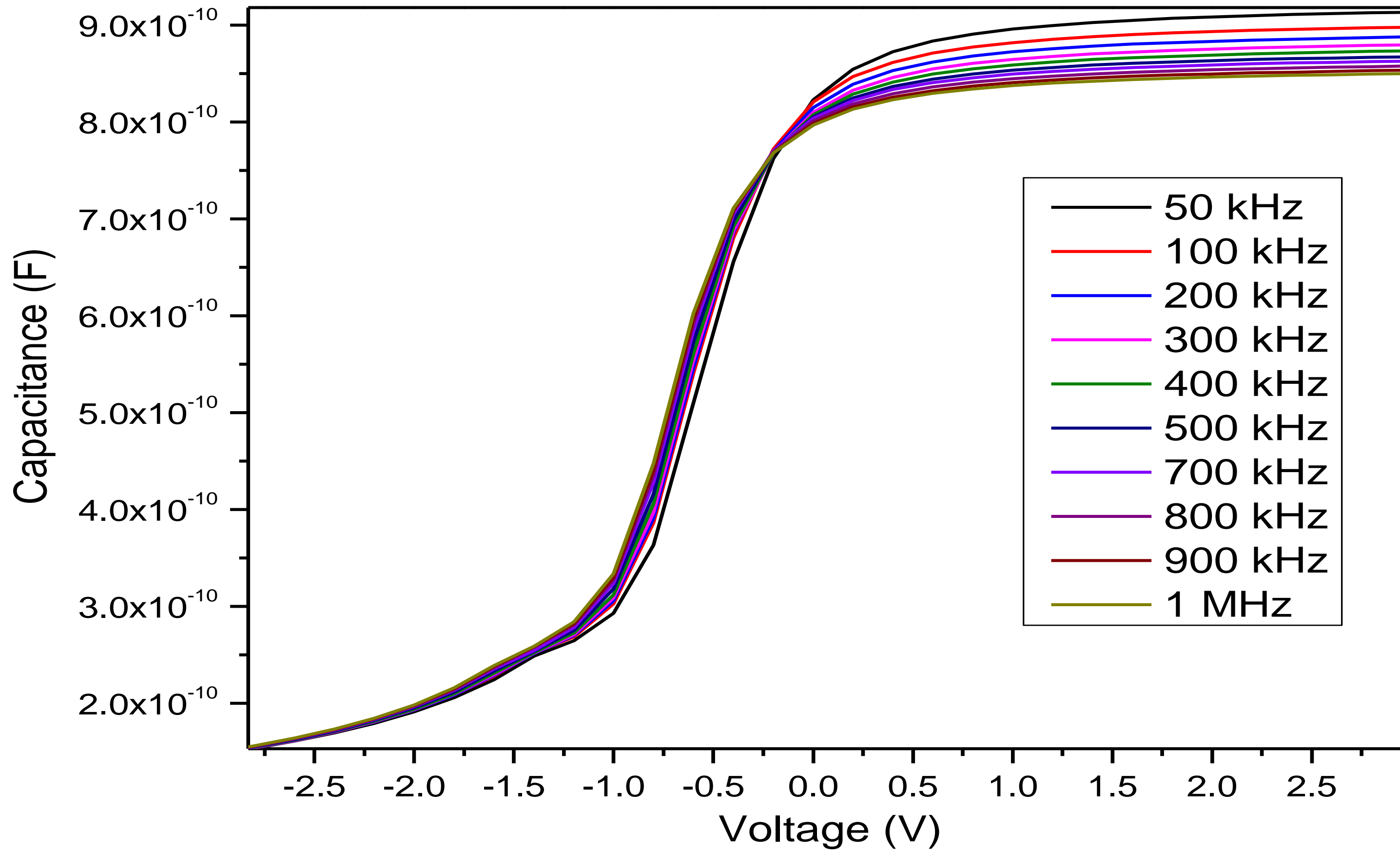

Transmission spectra as a function of wavelength for $Er_2O_3/Eu_2O_3/SiO_2$ Thin Films Grown on n-Silicon Substrate.



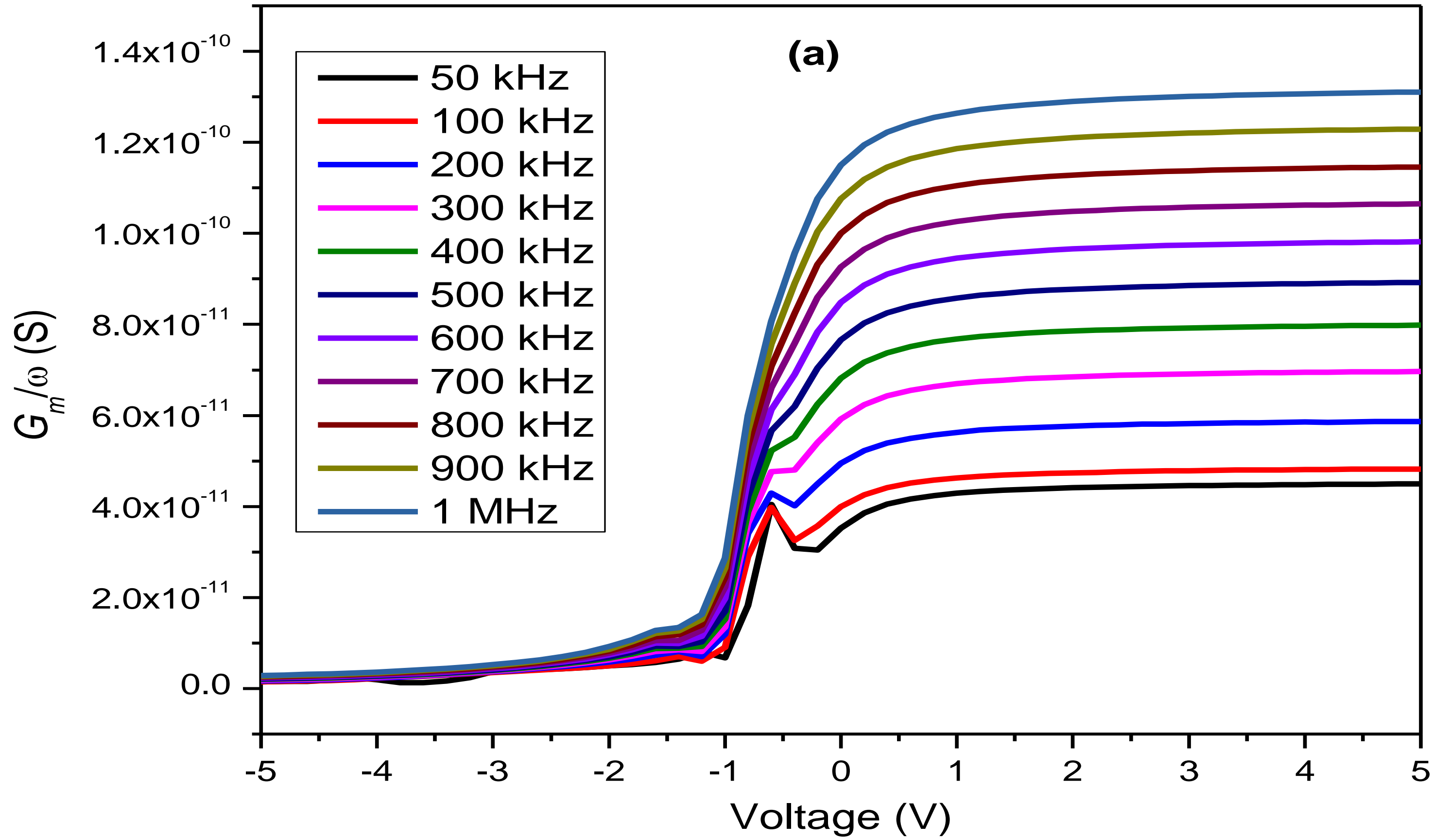

Absorptance spectra as a function of wavelength for $Er_2O_3/Eu_2O_3/SiO_2$ Thin Films Grown on n-Silicon Substrate.



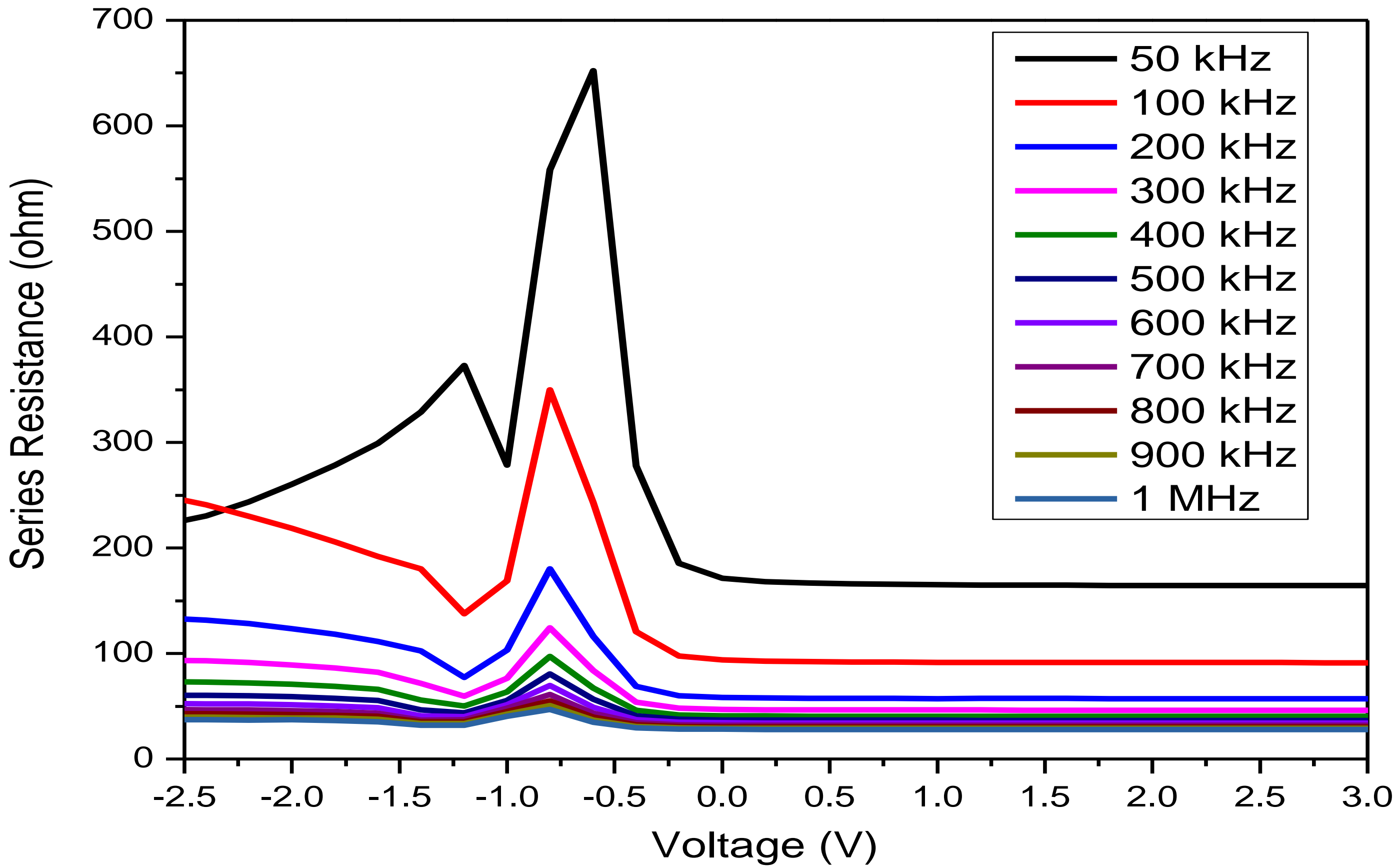

Reflection, Transmission and Absorptance of $Er_2O_3/Eu_2O_3/SiO_2$ Thin Films Grown on n-Silicon Substrate.




The measured capacitance – voltage ($C_m - V$) characteristics of Al/$Er_2O_3$/$Eu_2O_3$/$SiO_2$/*n*-Si/Al MOS Capacitors.




The measured conductance – voltage ($G_m/w - V$) characteristics of Al/$Er_2O_3$/$Eu_2O_3$/$SiO_2$/*n*-Si/Al MOS Capacitors.




Variation of the series resistance ($R_S$) as a function of voltage for different frequencies.

# CONCLUSION

From the optical and electrical characteristics of the fabricated $Er_2O_3/Eu_2O_3/SiO_2$/n-Si thin films and Al/$Er_2O_3/Eu_2O_3/SiO_2$/n-Si/Al MOS capacitors outcomes, we can conclude that reflection of the films increases with the increasing wavelengths while decreases with increase in the photon energies. It appeared that both the measured capacitance and conductance depend primarily on the frequency and the applied voltage. $C - V$ curves illustrated higher capacitance values at low frequencies and lower capacitance values at high frequencies. The measured conductance increases in the accumulation, depletion, and inversion regions with increasing frequency. At low frequencies small peaks are observed, but at high frequencies no peaks are observed. The causes of this behavior may be related to the interface states density, series resistance, and the frequency of the A.C. signal. Rs peaks appeared between – 1.17 and – 0.45 voltages. It is observed that the series resistance Rs values decrease with the increasing frequencies This demonstrates that the stacked gate dielectric is used to reduce the interface trap charge density. And this is due to the dipole formations of "–/+" polarity and "+/–" polarity at the fabricated $Er_2O_3/Eu_2O_3/SiO_2$ interface. The obtained values are in good covenant with today's metal-oxide-semiconductor based technologies

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Thanks For Your Attention. . .