General Audience Abstract:

Grazing Incidence X-ray scattering data was collected on two Hafnium Oxide (HfO_2) amorphous thin film samples. The pair distribution function (PDF) was calculated for both of them from the scattering data. The HfO_2 samples were made with differing atomic layer deposition (ALD) methods. One sample was made using Thermal ALD while the second was made using Plasma ALD. Both processes deposited the samples on top of a Chromium and Gold layer on top of Silicon Dioxide wafers. The process resulted in amorphous HfO_2 thin films of 50 nm thick. These samples were used to do grazing incidence X-ray scattering. The data was corrected for the scattering geometry. This data shows that the Plasma ALD sample results in a fully amorphous thin film while the Thermal ALD sample shows characteristics of crystalline materials in its scattering intensity curve. This appears to suggest that the Thermal ALD process results in a mostly amorphous material with small crystallites within it. The corrected data was then used to calculate the PDF for both samples. The PDF shows for Plasma ALD sample there is a structure up to about 10 Å and after that there is no structure. The Thermal ALD PDF shows it has the same structure as the Plasma up to 10 Å. After this point, Thermal also showed peaks in the PDF up to 20 Å. This suggests some long range order in the sample which could be small crystallites.

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