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Influence of enhanced ion bombardment on groove filling, roughness and electrical insulation of magnetron sputtered dielectric films

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One approach of improving properties of magnetron sputtered films is to combine the film growth with energetic ion bombardment. In the experiments presented in this paper, a reactive pulse magnetron sputtering process for the deposition of SiO_2 and $AlSiO_x$ films was used. Two techniques to enhance the ion bombardment of the growing film were investigated. First rf substrate bias was applied simultaneously during stationary film deposition. Secondly, an ion beam perpendicular to the substrate surface was applied alternately with the film deposition.
Structured Si wafers with grooves of various width, distance and depth were used to investigate groove filling. With both techniques, complete filling of the grooves was achieved up to an aspect ratio of 1:1. Nearly flat film surfaces were achieved, depending on film thickness, groove depth, width and distance. Results for the different substrate surface morphologies can be explained quite consistently with the angle dependency of the sputter yield.
With stationary coating and rf bias also roughness evolution during coating of rough steel substrates and electrical properties of $AlSiO_x$ films were investigated. Different types of roughness were considered and a dependence between the lateral dimensions of the roughness and the required layer thickness for roughness reduction was found. Electrical resistivity increased with rf bias especially for thick layers.

Keywords
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