Effect of Annealing on Surface Morphology and Wettability of NC-$FeSi_2$ Films Produced Via Facing-Target Direct-Current Sputtering

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Employing facing-target direct-current sputtering, nanocrystalline iron disilicide (NC-$FeSi_2$) films were created at room temperature. The NC-$FeSi_2$ films were annealed at different temperatures of 300 °C, 600 °C, and 900 °C under high vacuum for 2 hours. The morphology and roughness of film surfaces were investigated by filed-emission scanning electron microscopy (FESEM) and atomic force microscopy (AFM). The wettability properties of the films were studied by measurement of the contact angle. Based on the FESEM micrographs in plane view, the unannealed NC-$FeSi_2$ films were composed of a large amount of small uniform crystallites with diameters of 6-7 nm. At an annealing temperature of 300 °C, the small uniform crystallites were merged and formed into the small nanocrystalline clusters. At annealing temperatures higher than 300 °C, the small uniform crystallites were clustered and became large clusters. From an AFM micrograph, the unannealed NC-$FeSi_2$ films showed a very smooth surface with a root mean square roughness of 0.81 nm, which was increased by annealing. The unannealed NC-$FeSi_2$ films exhibited an average contact angle of 100.0°, which was higher than 90°. This demonstrated that the NC-$FeSi_2$ film surface was hydrophobic, which showed the possibility for utilization in self-cleaning surface applications. At an annealing temperature of 300 °C, the film surface exhibited the highest contact angle of 106.2°. The average contact angle were decreased at annealing temperatures higher than 300 °C.