Avoiding blistering in Al2O3 deposited on planar and black Si

Aluminum oxide (Al2O3) fabricated by atomic layer deposition (ALD) has during the last decade emerged as an excellent surface passivation material for both planar and micro/nanostructured silicon. The post-ALD thermal treatment required to activate the surface passivation of Al2O3 results often in blistering and film delamination. Here, we studied how several fabrication steps affect blistering and the quality of surface passivation by Al2O3. Decreasing the fraction of blistered area on planar Si surfaces results in lower surface recombination velocity, in agreement with previous reports. By using simple analytical expressions, we estimated that surface recombination is at least 20 times faster at the blisters than at the non-blistered areas. Exposing the Si surface to a reactive ion etch (RIE) treatment as short as 30 s is enough to suppress blistering. Anti-reflective nanostructured Si (black Si) fabricated using the same RIE process by increasing the RIE time does not suffer from blistering either. Finally, we investigated the effective lifetime of black Si textured surfaces and we implemented a pre-ALD conditioning routine that dramatically improves the quality of passivation by Al2O3 on black Si.