Black Silicon realized by reactive ion etching (ICP) without platen power

Reflectance and minority carrier lifetime were measured for black silicon textured by different inductively coupled plasma (ICP) reactive ion etching processes without any capacitively coupled power (platen power). Reflectance was reduced to below 5% after 2 minutes and below 4% after 3 minutes etch time, with several accessible routes to lower reflectance identified. Black silicon wafers were passivated by atomic-layer deposited (ALD) Al₂O₃ and minority carrier lifetime was measured to 2.1 ms for 2 minutes texturing, while minority carrier lifetimes were well below 1.0 ms for etch times in the 5-20 min range. Samples measured immediately after ALD activation, show minority carrier lifetime above 3 ms for RIE process time between 1.5 and 3 min and between 2.5 and 3 ms for etching times above 3 min. These results indicate that ultra-low reflectance and minority carrier lifetime on par with those of the best passivated solar cells to date may be achieved after texturing for just 2 min.