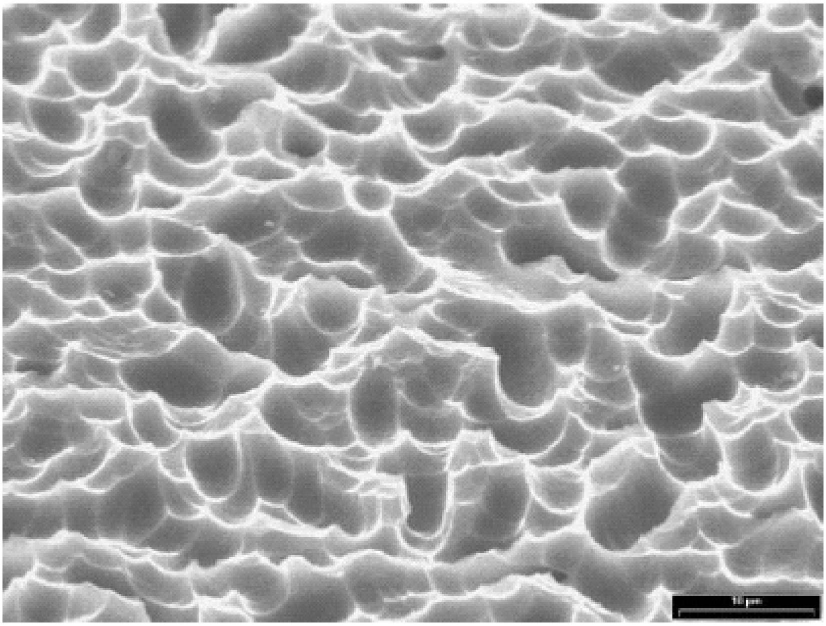

Figure 7.12 Mc-Si surface after acid etching. (Reprinted from *Solar Energy Materials and Solar Cells*, **74**, Szulfcik J, Duerinckx F, Horzel J, Van Kerschaver E, Dekkers H, De Wolf S, Choulat P, Allebe C and Nijs J, "High-efficiency low-cost integral screen-printing multicrystalline silicon solar cells", 155–164, (2002), with permission from Elsevier Science)

surface damage. With this technique, efficiency gains of 5% (relative) after encapsulation have been reached [107]. Contact fingers should be screen printed parallel to the grooves, on plateaus left untextured to ensure easy printing, so that some kind of alignment is maintained. Other contacting alternatives can be implemented, such as roller printing [108] or buried contact [109]. Currently, automated systems are being developed to check industrial feasibility.

Another approach is scribing grooves by laser [110]. Upright pyramids of 7-μm height can be created by two orthogonal sets of parallel grooves, followed by a chemical etch to remove the silicon residues. Combined with a single layer ARC, laser texturing can reduce weighted reflectivity to 4%, half of that given by anisotropic etching and the same AR coating. Adjustments have been made to obtain smoother and smaller grooves, in order to adapt the technique to a screen-printed process.

7.6.3.3 Reactive ion etching (RIE)

Reactive ion etching (RIE) texturization of silicon in chlorine plasma is a dry isotropic etching process that creates a surface with a high density of steep etching pits, with typical dimensions below 1 μm (see Figure 7.13) [111]. Increases of up to 1.4 $mA{\cdot}cm^{-2}$ in short-circuit current compared to anisotropic texture have been reported with a maskless technique [112]. RIE can also be performed in conjunction with a masking layer to produce more regular features [113]. The main obstacle in industrial implementation is too