

Application Note

High-resolution SPM measurements of injection-moulded plastic parts

Application

When manufacturing very smooth surfaces of plastic that are to be metallized, such as CDs, CD-Rs, DVDs and headlight reflectors, a mould (stamper) is initially manufactured from which moulded parts are then produced by injection moulding. After hundreds or thousands of operations, streaks or milky smears can appear on the mould and moulded parts. Until now it was assumed that these were due solely to the "evaporation" of highly volatile constituents of the processed plastic (additives) that had settled on the mould. However, if this were true, the mist that lies on the mould should be reflected as a depression in the moulded part, but this is not the case, as demonstrated in the example below. The very clear "misty covering" on the vaporised moulded part, which can be seen with the naked eye, is raised and has a number of peaks. The surface is no longer absolutely smooth as glass, but is spiky. The peaks look as though they have been teased out of the moulded part. This has devastating consequences for headlight reflectors or CDs. If a number of these faults occur, the product can become absolutely useless. Of course, such defects can also be detected by means of light microscopy, but even with the highest resolution it is impossible to see whether the surface is smooth or rough.

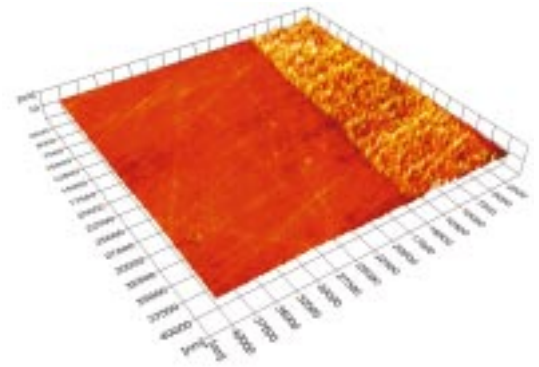
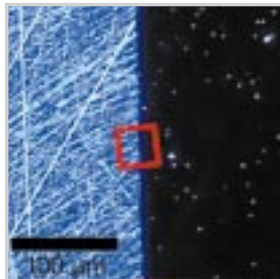
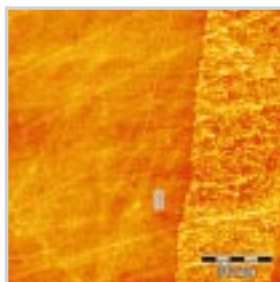


Fig.: 3D NANOSTation II image

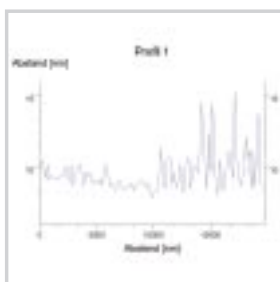
Results



Thanks to the use of the *NANOSTation II* scanning probe microscope from S.I.S., it was discovered that the streaks are a rough (spiky) coating. The illustration on the left shows a 2D image of the transition from streaks (right) to the smooth surface (left) as well as a profile section through both areas. The original smooth surface is rough and uneven. The plastic stuck to the mould at these points, producing these miniature peaks during removal from the mould. Thus, the streaks are not a coating on the mould, but the adhesive effect of the plastic to the mould. This could only be detected by the use of a scanning probe microscope (SPM).



Top left: Optical image of the transition from streak to undamaged sample surface (DIC)
 Left: 2D *NANOSTation II* image of the surface, left undamaged sample area, right streaks
 Bottom left: Section through 2D *NANOSTation II* image, left undamaged sample area, right streaks



Measuring conditions

The measurements were carried out at Bayer AG, Leverkusen (Department KU-EU/KFC) with a *NANOSTation II* with 40 µm scanner and special holder for CD inspection in the non-contact mode.

Further fields of application

Quality control during the production of smooth plastic parts such as CDs, DVDs, and reflectors.