Supplementary Material (ESI) for Lab on a Chip

Bonding of microfluidic devices fabricated in polycarbonate.

D. Ogończyk, J. Węgrzyn, P. Jankowski, B. Dąbrowski and P. Garstecki

Supporting Information

1) XPS measurement

We used XPS to determine the atomic composition of the top (native) layer and of the bulk (with the native surface milled off) layer of the polycarbonate slabs in order to confirm the presence of a protective coating on the surface of PC. The results revealed differences in content of the surface layer and of the bulk, principally in the amount of silicon, Fig.S1. Measurements were performed on a VG Scientific photoelectron spectrometer ESCALAB-210 using A1 Ka radiation (1486.6 eV) from X-ray source operating at 15 kV and 20 mA..

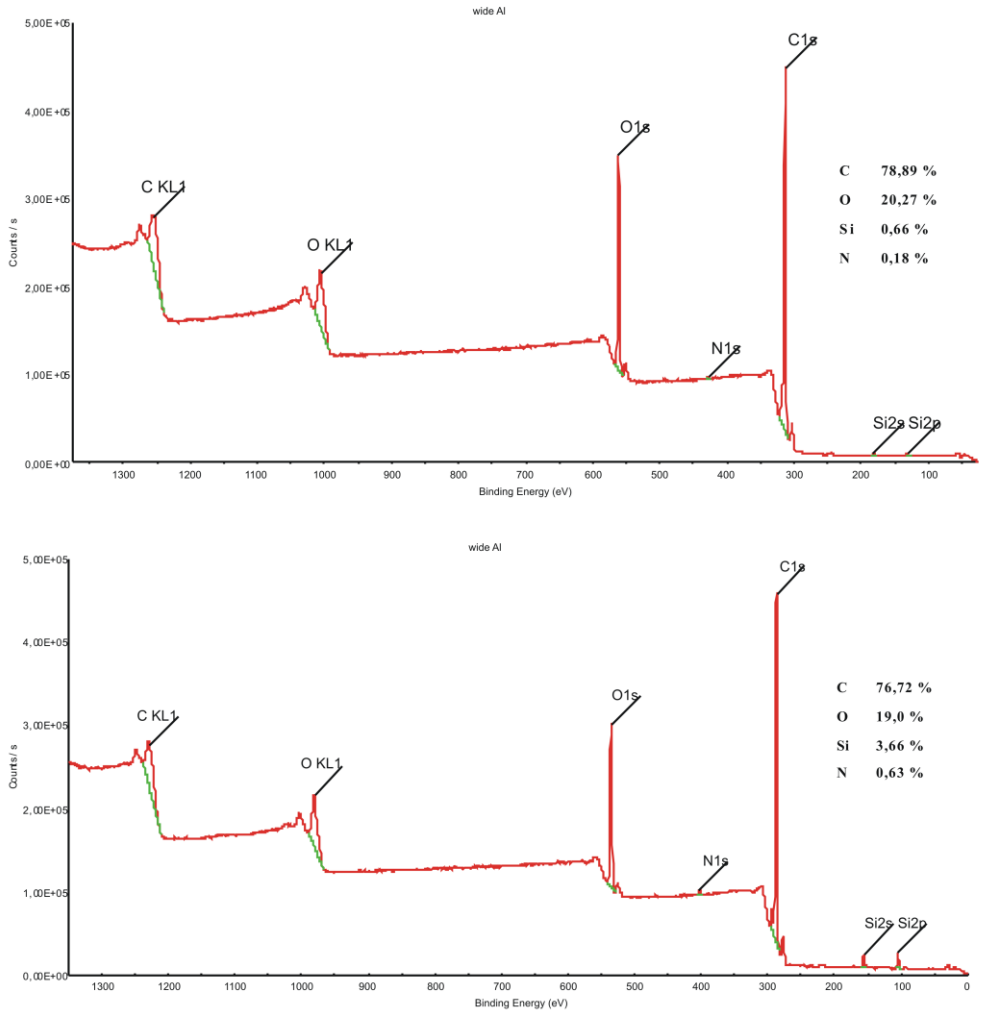

Fig.S1 XPS spectra of PC: top layer (at the top) and inside layer (at the bottom)

2) Testing the strength of the seal.

We used two methods to test the strength of the seal obtained via the method described in our report. Below we describe both methods and the results that they yielded.

i) Pressurized chamber fabricated in polycarbonate. We prepared two 20 x 20 mm slabs of polycarbonate (PC): one plane and thin (thickness of 0.75 mm) plate, and one thick (thickness of 5 mm) with a round chamber milled in. The diameter of the chamber was 10.4 mm and its height was equal to 1 mm. The chamber was equipped with a through-hole (of diameter of 1.2 mm) that allowed us to pressurize the chamber after bonding the two plates. Fig. S2. shows both slabs prior to bonding.

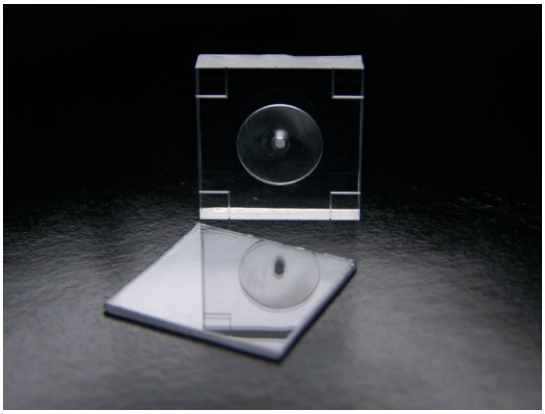

Fig.S2 PC slabs used in the experiment that verified the strength of the bond.

After bonding the two PC slabs and gluing in the tubing we immersed the such formed system in a water bath and slowly raised the pressure of Nitrogen applied to the chamber. Appearance of bubbles escaping from the system corresponded to the delamination of the two slabs and loss of seal. Ruptures typically occurred above 0,4 MPa. These experiments allowed us to observe that an elevated temperature of bonding provided tightest seals: the highest values (0.6 MPa) of pressure at which the systems ruptured were obtained for the highest tested temperature of bonding (135^{o}C).

ii) Direct verification of the critical normal stress. We used pairs of 5 mm thick, plain PC slabs, with through-holes running through them, parallel to the surface of bonding, to assess directly the critical normal stress. In the experiment, we first bonded two such plates, and then used the through-holes to attach thin wires. We hanged the top plate with the use of the wire, and attached a weighed bottle to the bottom one (also with the help of the wire). We then slowly poured water into the bottle until the bond between the plates broke. We used two kinds of plates: pairs of 5 x 5 mm (25 mm^2) and pairs of 10 x 10 mm (100 mm^2). In the case of smaller slabs we recorded failures at about 1,7 kg of the weight attached to the bottom plate. For the larger plates this weight was ~ 4,2 kg. The average critical normal stress was equal to ~ 0,55 MPa.