Electronic Supplementary Material (ESI) for RSC Advances.

Electronic Supplementary Information

Direct bonding of liquid crystal polymer to glass

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Fig. S1 Schematic diagram of a Hybrid Plasma Bonder (HPB, adopted from M. M. R. Howlader, M. G. Kibria, F. Zhang and M. J. Kim, *Talanta*, 2010, **82**, 508–15). The HPB system can accommodate wafers of up to 200 mm diameter. It consists of a plasma activation chamber and an anodic bonding chamber. The plasma activation chamber can be used for both reactive ion etching (RIE) and microwave (MW) plasma activation. The two activation sources are separated into bottom and top compartments by an ion trapping metallic plate, where the RIE and MW plasma are generated from O_2 and N_2 gases, respectively. The metallic plate has holes of diameter 1 mm, which can trap charged ions and thus help in producing neutral radicals at the bottom compartment. For sequential plasma-activated bonding (SPAB), no heat is required for wafer bonding, or to increase the bonding strength. The anodic bonding chamber is equipped with high voltage electrodes, and heaters that are attached to the bonding heads. After SPAB, when the bonded wafers are subjected to an application of a high voltage (1kV) at 200 ºC, an electrostatic force develops across the bonded interface. The anodic-voltage and temperature treatments enhance the bonding strength of the pre-bonded wafers. Also, this HPB (i.e., SPAB + anodic treatment) allows for removing gas-led voids across the interface.

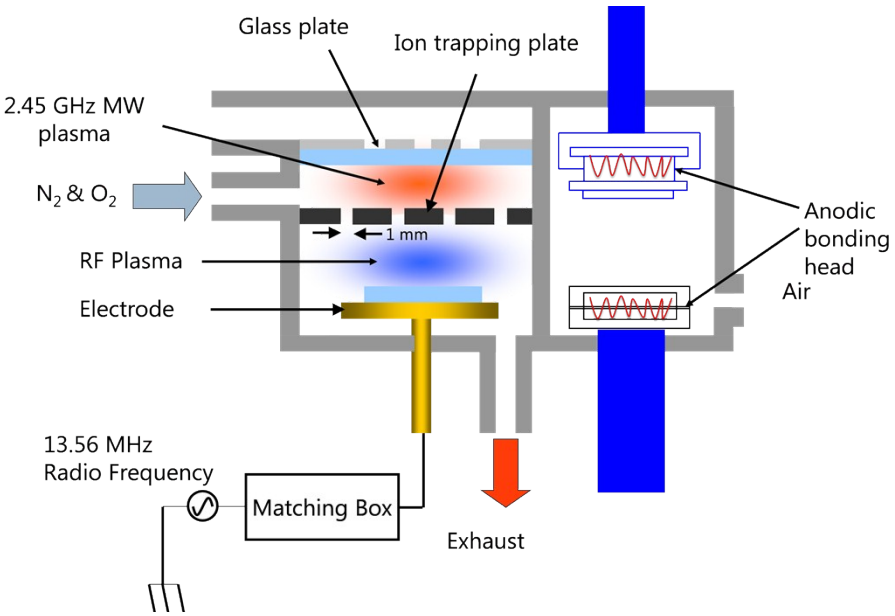


Fig. S2 Contact angles of LCP and glass surfaces in different treatment conditions.

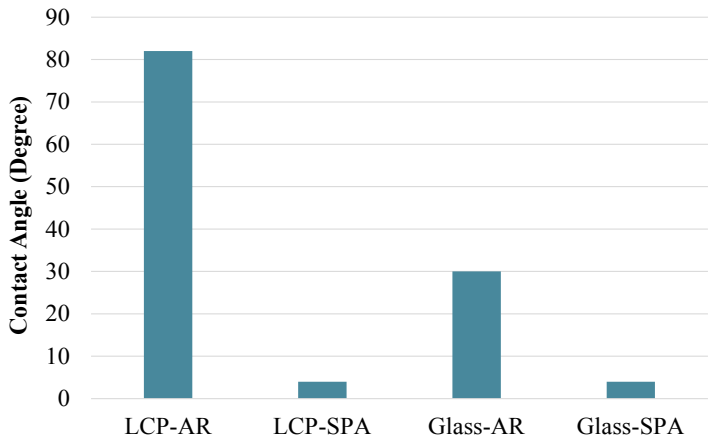


Fig. S3 (a) Bonding strengths of LCP-glass at different bonding conditions. (b) Picture showing the use of the tensile pulling for measuring the bonding strength.

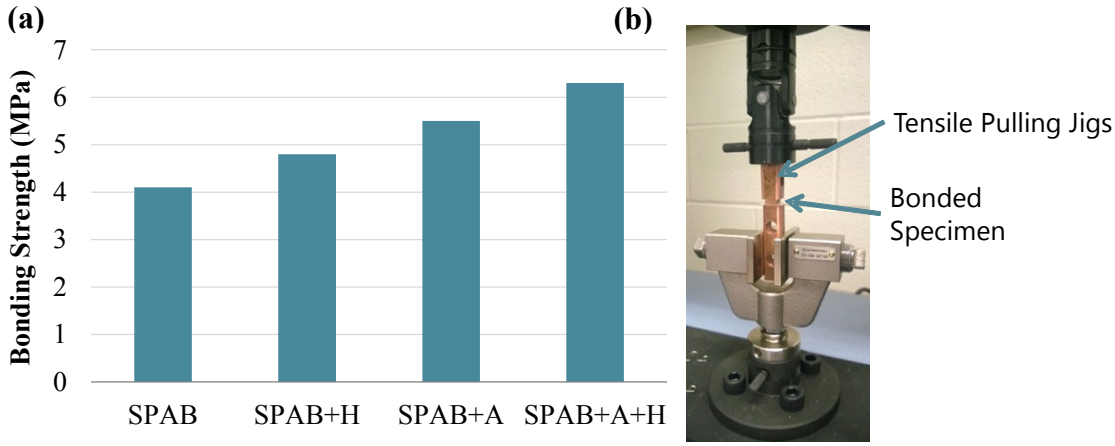


Fig. S4 Percentage area calculation for the deconvolved peaks of: (a) The O_{1s} peak on the glass side; (b) The C_{1s} peak on the LCP side. The peak of C-C/C-H, C-O, and O-C=O is labeled as 1, 2, and 3, respectively.

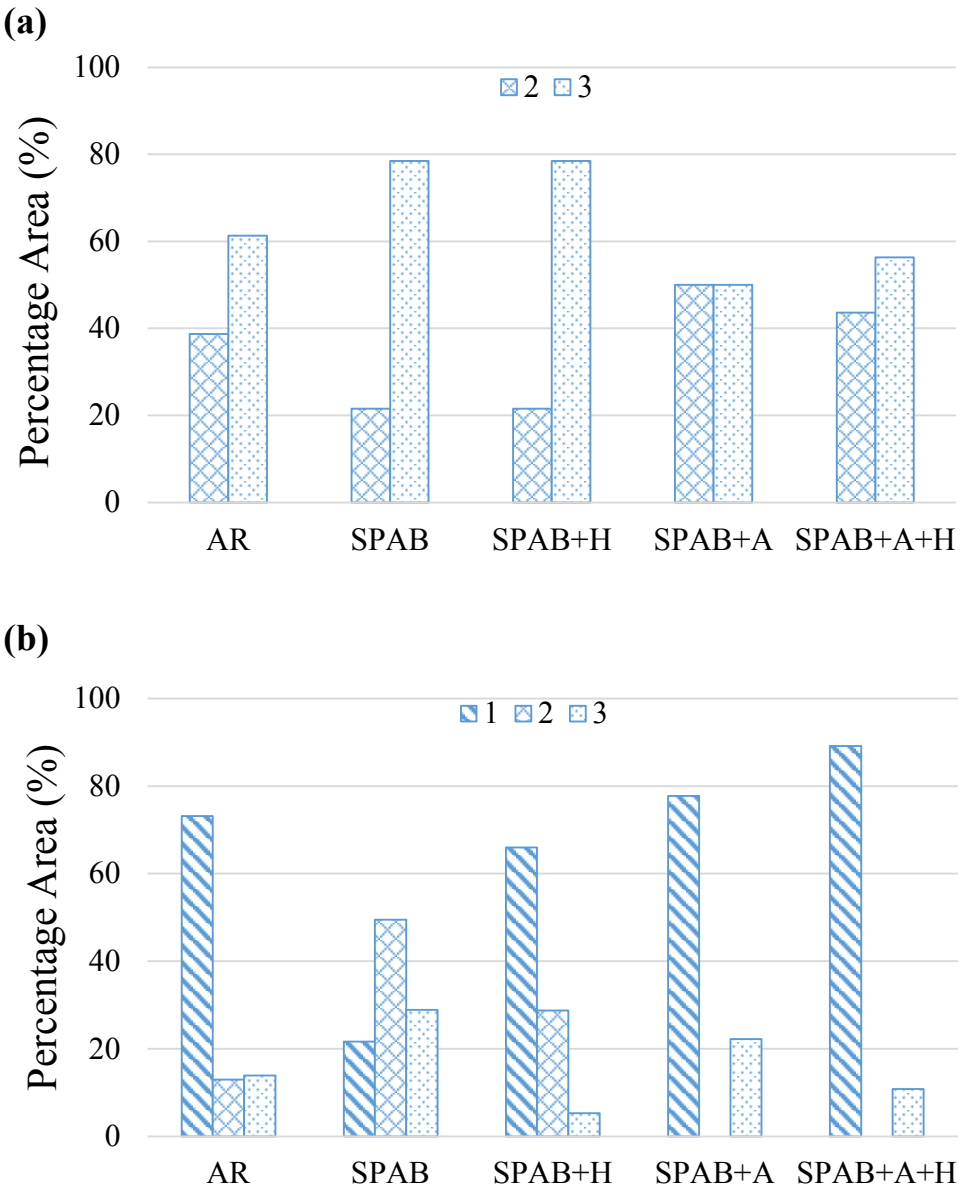
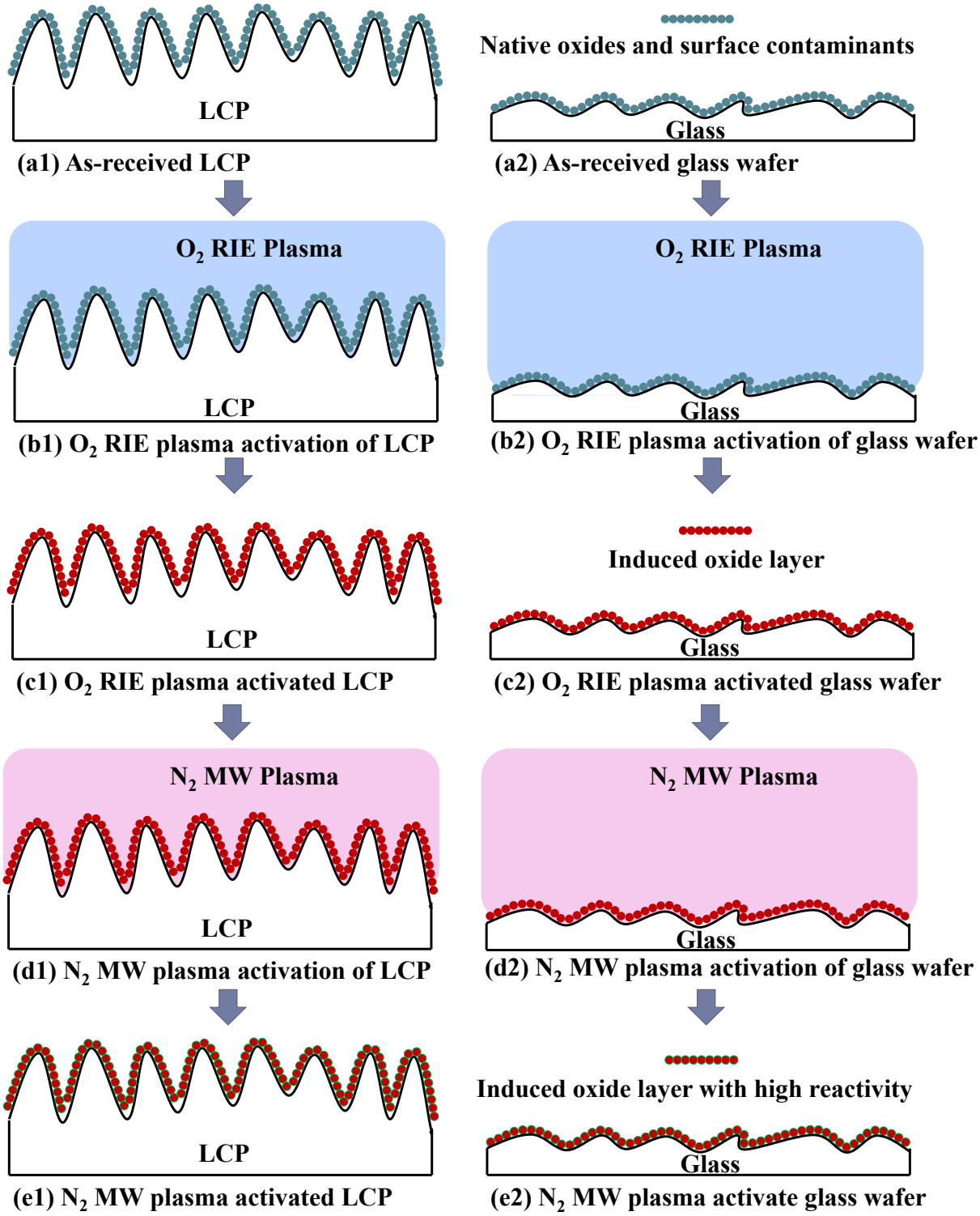


Fig. S5 The plasma activation steps for bonding LCP to glass.



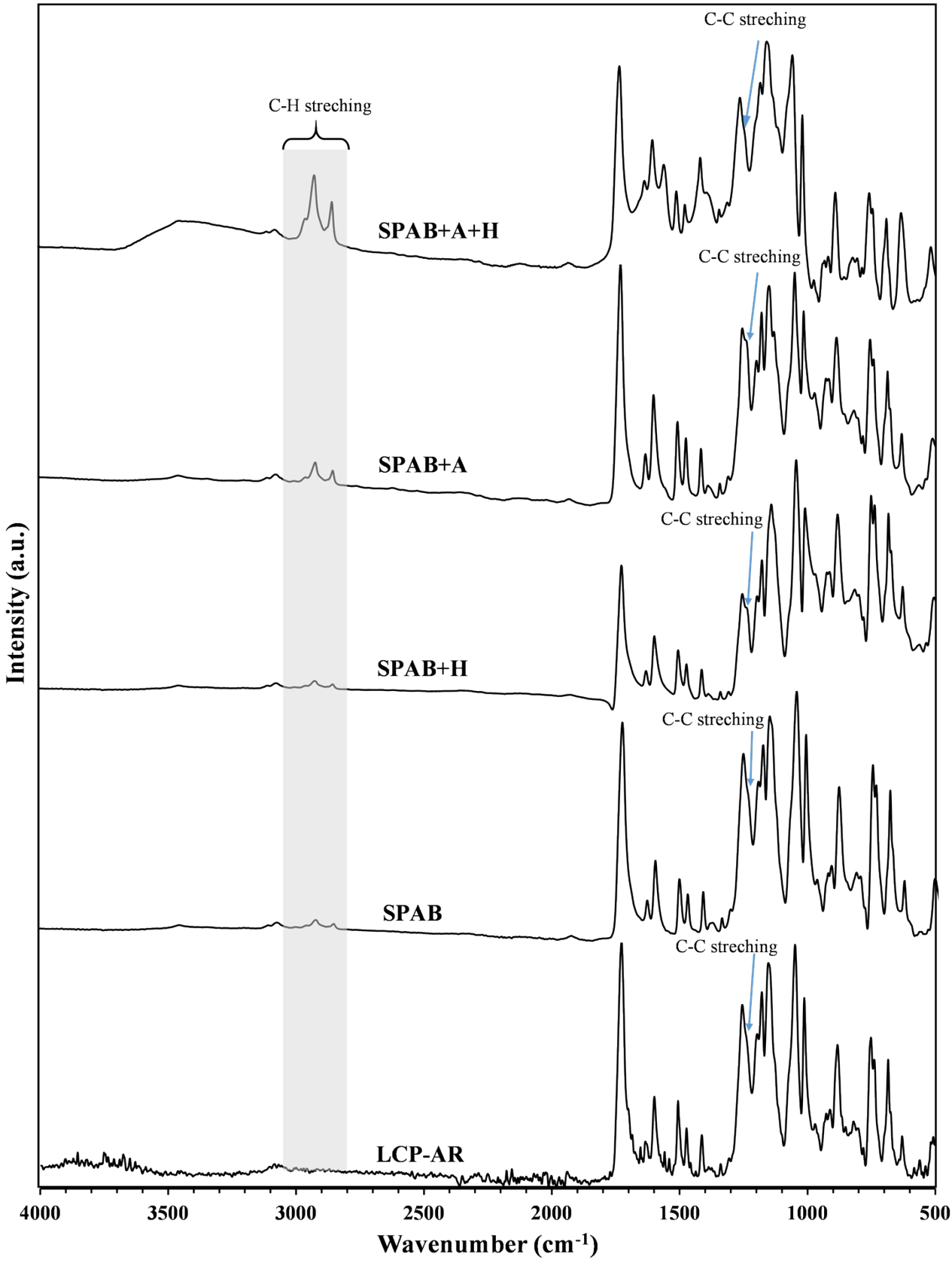


Fig. S6 The attenuated total reflectance FTIR (FTIR-ATR) absorbance spectra of debonded LCP surfaces in SPAB, SPAB+H, SPAB+A, and SPAB+A+H with respect to that of as received LCP surface (LCP-AR). The C-H and C-C stretching peaks are in the range of 2800-3000 cm^{-1} and 1200 cm^{-1}, respectively.