Supporting information

5 Micro channel waveguide fabrication and characterization

High refractive of core material and low refractive of clad material are required for fabricating channel waveguide. The cladding material was made from a mixture of 48.1wt% tetraethyleneglycol diacrylate, 48.1wt% MPS modified SiO_2 nanoparticle and 3.8 wt% Irgacure 651, with a refractive index of 1.4884. The core material was made from a mixture of 46.2 wt% tetraethyleneglycol diacrylate, 11.5 wt% fluoroimidoacrylate FIA, 38.5wt% MPS modified SiO_2 nanoparticles, and 3.8wt% Igracure 651, with a refractive index of 1.4962.

The 10 micron thick cladding layer was placed on the glass substrate (2 cm x 2 cm) using a knife coater and cured with 365 nm UV light (1.86 mW/cm^2, ENF-240C, Spectroline) for 20 sec. The core material with a thickness about 7 μm was placed on top of the cladding layer using a knife coater. A quartz mask with a 5 micron channel pattern was place on top of the core layer, and then the sample was under the 365 nm UV exposures for 8 sec. The unexposed area was washed out with acetone. The sample was post baked at 100^{o}C for 2 min. Figure 1S shows the 5 μm channel waveguide has been fabricated with good resolution. The optical loss of the channel waveguide was measured using cut back technique using 100 micron channel

waveguide. The loss has been determined to be 1.18 dB/cm at 1310 nm. The waveguide is useful for the local area communication backplane.

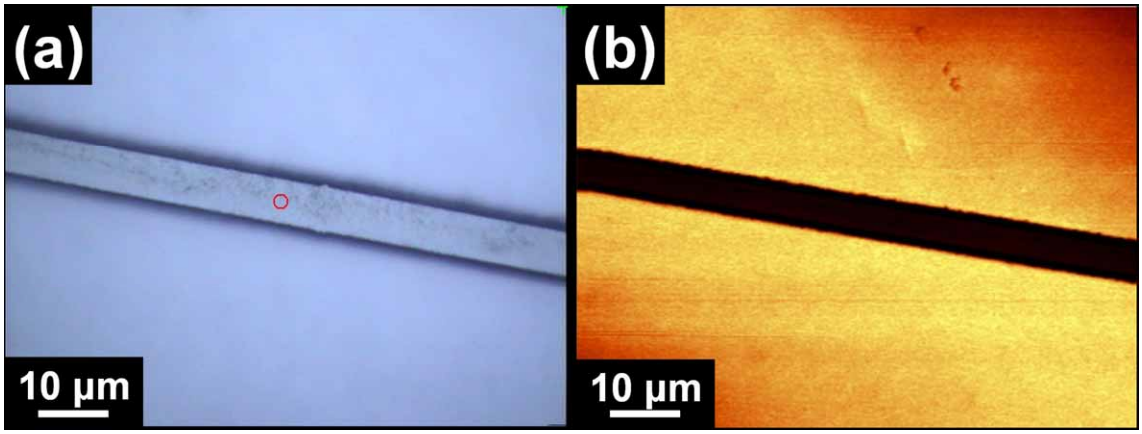

Figure 1S 5 micron channel waveguide fabricated from fluoroimide acrylate/SiO_2 nanocomposite (a) optical micrograph and (b) confocal micrograph.

FTIR and NMR characterization

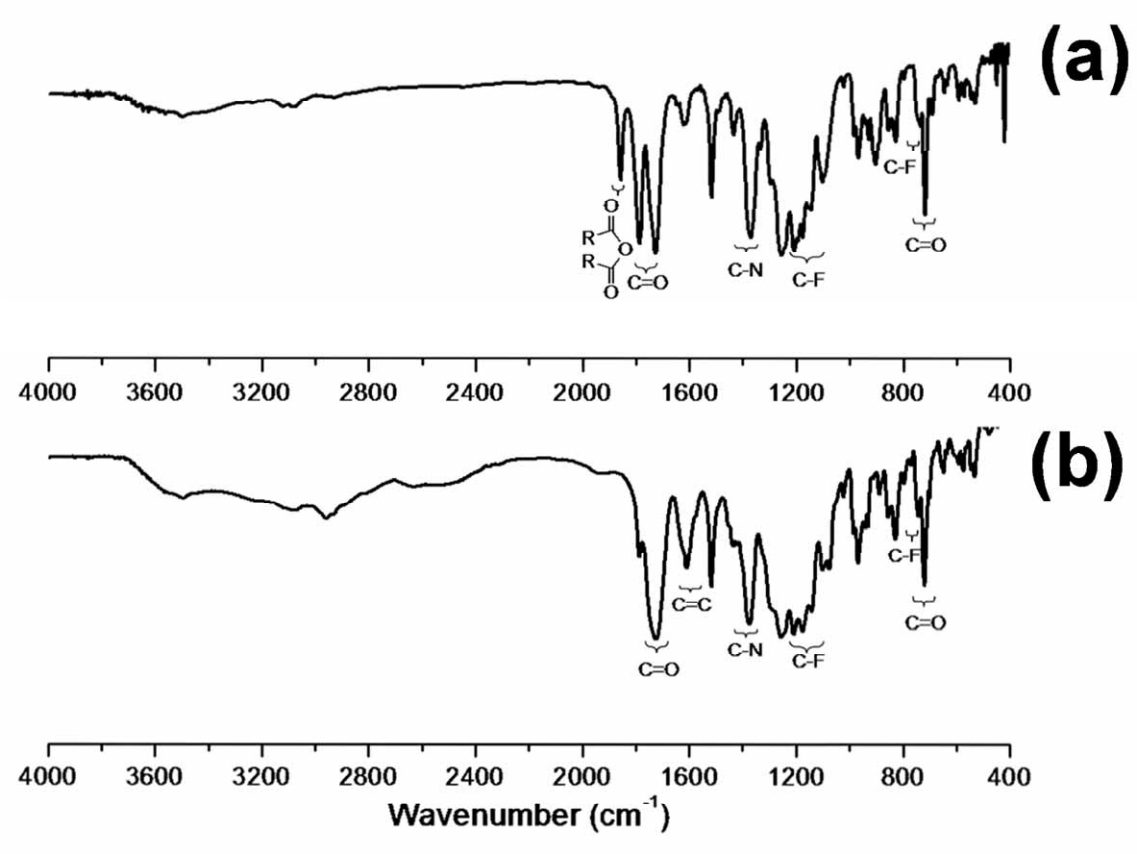

Figure 2S FTIR Spectra of (a) FIDA and (b) PSFIA oligomer

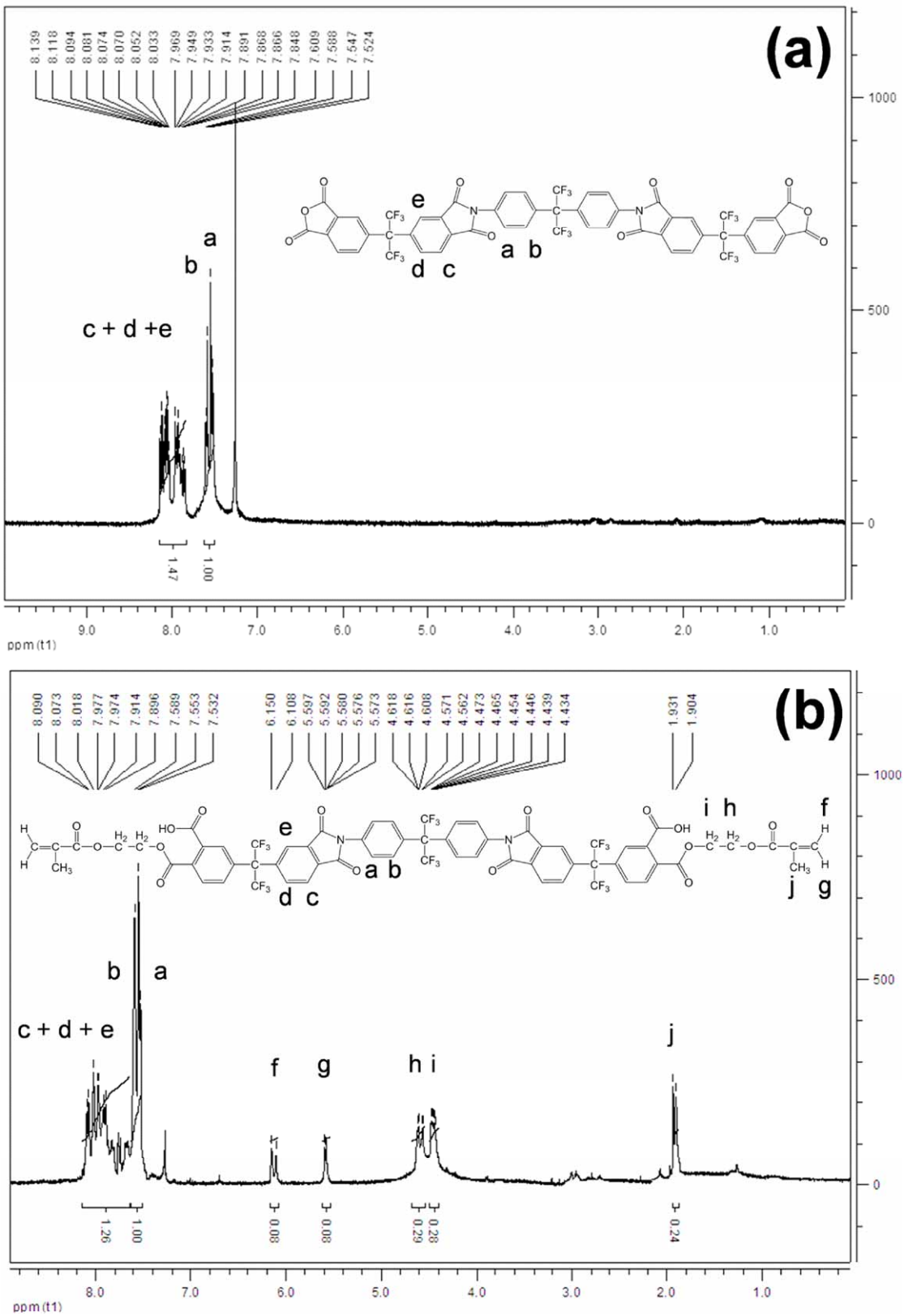

Figure 3S NMR Spectra of (a) FIDA and (b) PSFIA oligomer

DSC study of cured nanocomposites

The NPS60 sample was used to illustrate how completeness of the cure of nanocomposite can be determined by DSC. The NPS60 samples are cured by UV then heat post cure to make sure the sample are fully cured. A 4.85 mg cured NPS60 disc sample was heated from -10 ^{o}C to 200 ^{o}C at 10 ^{o}C/min ramping rate. After the first run of DSC was completed, the sample was cooled down to room temperature slowly, and then the second run of DSC started from -20 ^{o}C to 200 ^{o}C at ramping rate of 10 ^{o}C/min. There is no exothermic peak observed in both DSC runs, so the NPS60 samples are fully cured before subjecting to different characterizations.

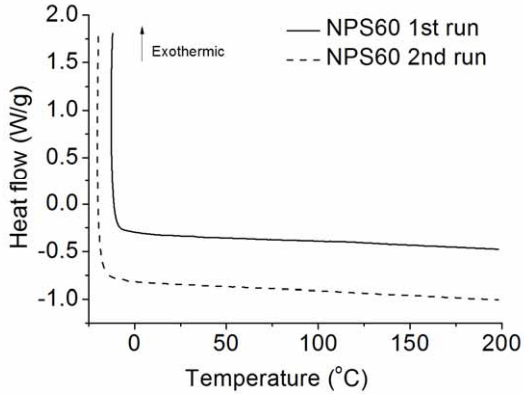

Figure 4S DSC Thermogram of cured NPS60 nanocomposite.

Contact angles of acrylates

The contact angles of UV-cured NPGDA, EOBDA and TPSFIA have been measured to determine the hydrophobicity of acrylate monomer and oligomer.

T-PSFIA shows the highest hydrophobicity among these three acrylates used in this study.

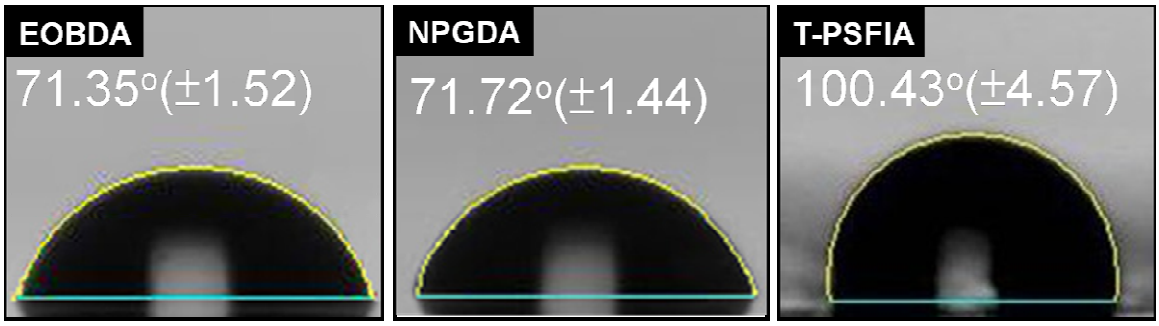

Figure 5S Photos of contact angles of NPGDA, EOBDA and T-PSFIA