Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Elastic broadband antireflection coatings for flexible optics using multilayered polymer thin films

Yineng Zhao,[a] *Ni Huo,*[b] *Sheng Ye,*[c] *and Wyatt E. Tenhaeff*[*, a, b]

wyatt.tenhaeff@rochester.edu

[a] Materials Science Program and [b] Department of Chemical Engineering, University of Rochester, Rochester, New York 14627, United States

[c] Meta Reality Labs, 9845 Willows Rd, Redmond, Washington 98052, United States

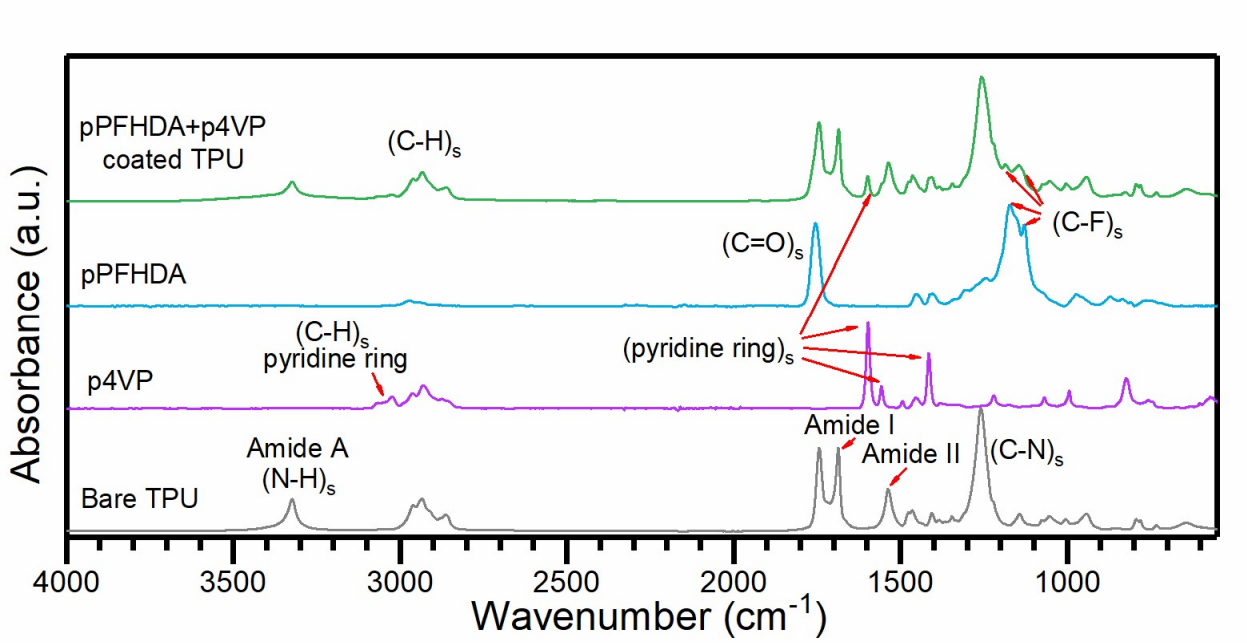

Figure S1. FTIR-ATR spectra of the two-layer polymer coating on TPU, pPFHDA homopolymer, p4VP homopolymer, and bare TPU. ATR correction was applied. ('d' denotes deformation; 's' denotes stretching.)

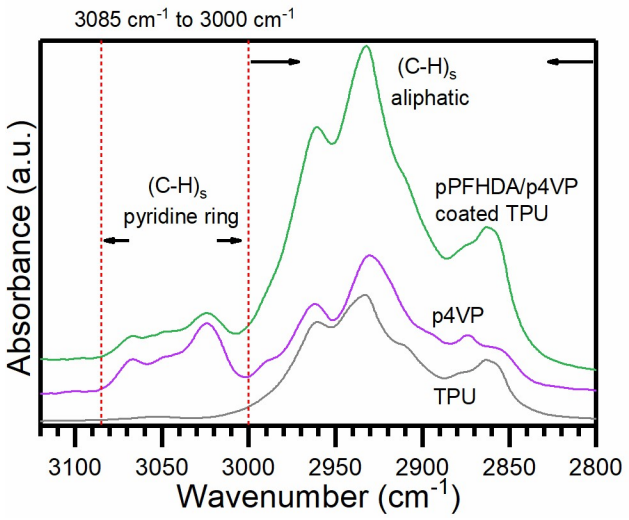

Figure S2. FTIR-ATR spectra of the two-layer polymer coating on TPU, p4VP homopolymer, and bare TPU between 3120 and 2800 cm^{-1}. ATR correction was applied during data collection. ('s' denotes stretching.)

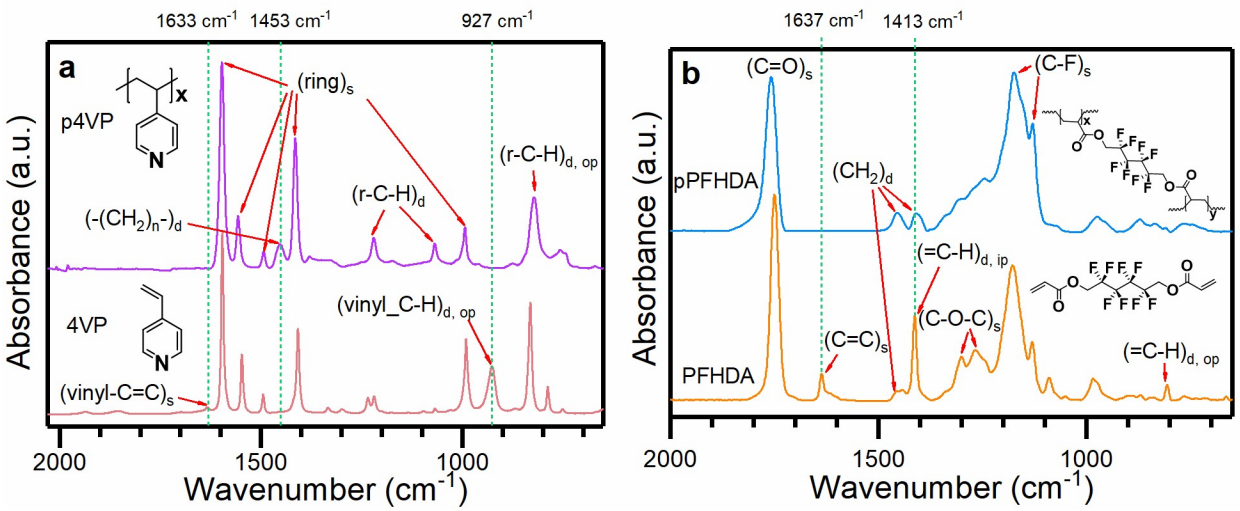

Figure S3. FTIR-ATR spectra of the a) 4VP monomer and p4VP homopolymer; b) and PFHDA monomer and pPFHDA homopolymer between 2000 and 650 cm^{-1}. ATR correction was applied during data collection. ('r-' denotes 'pyridine ring'; 'op' and 'ip' denote 'out-of-plane' and 'in-plane'; 'd' denotes deformation; 's' denotes stretching.)

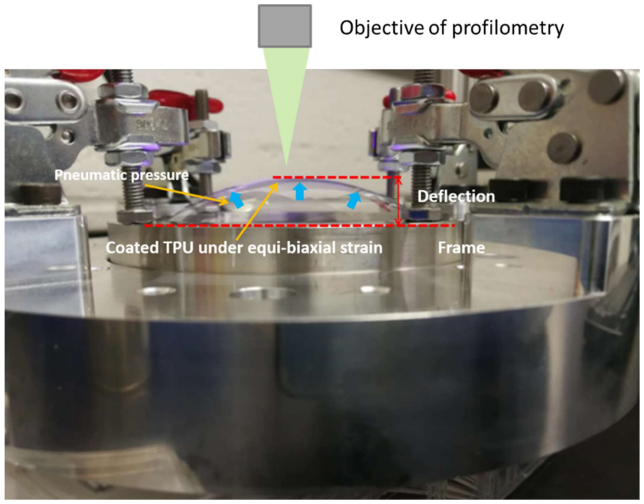

Figure S4. Digital photograph of the bulging device with an illustration of the in situ profilometry set-up.

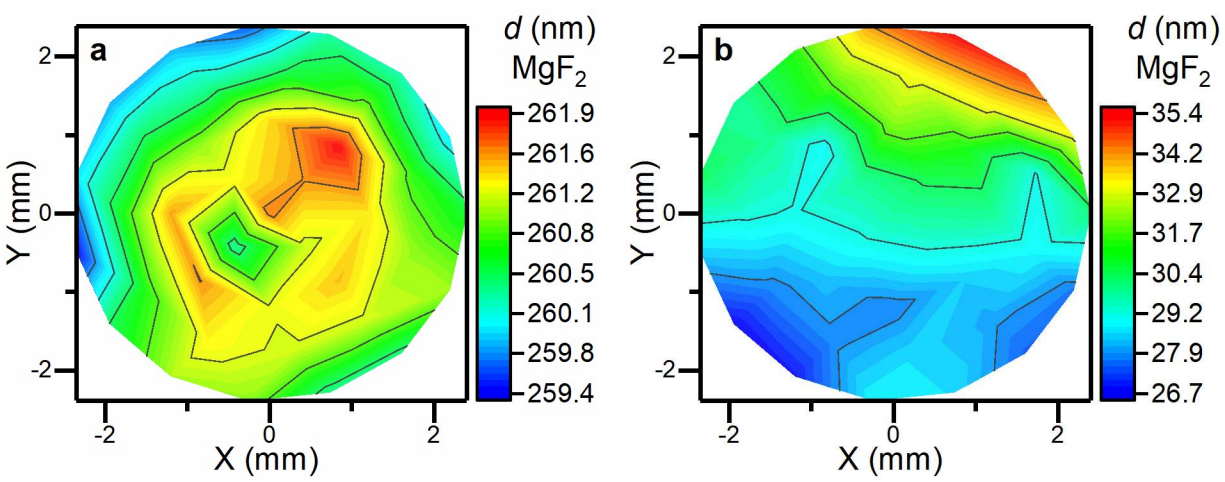

Figure S5. Thickness contour map of the (a) thick and (b) thin MgF_2 coating on TPU, measured ellipsometrically. The mapped area is 18.1 cm^2.

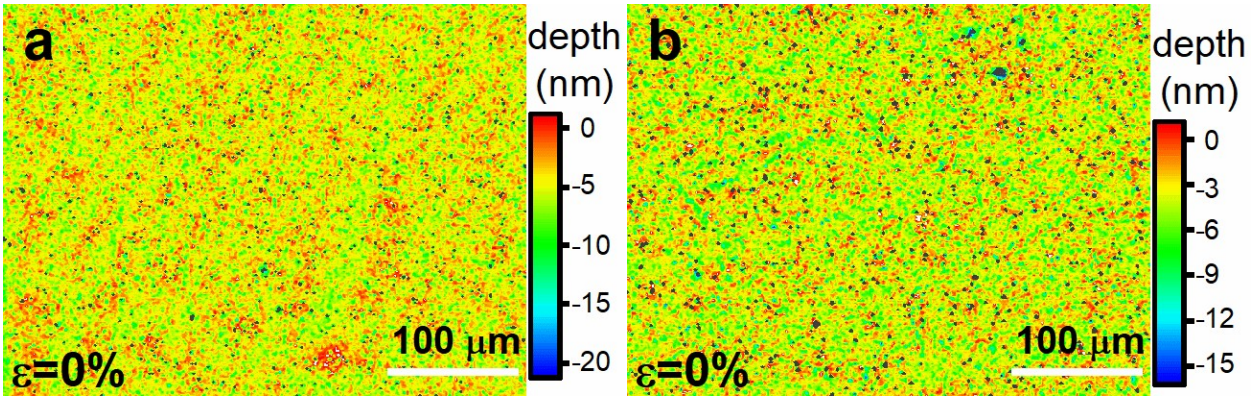

Figure S6. The surface topography of the two-layer polymer ARC coated TPU measured at zero strain (a) before and (b) after the first application of strain to ε=1.64%. The scanned area is 400×300 μm.

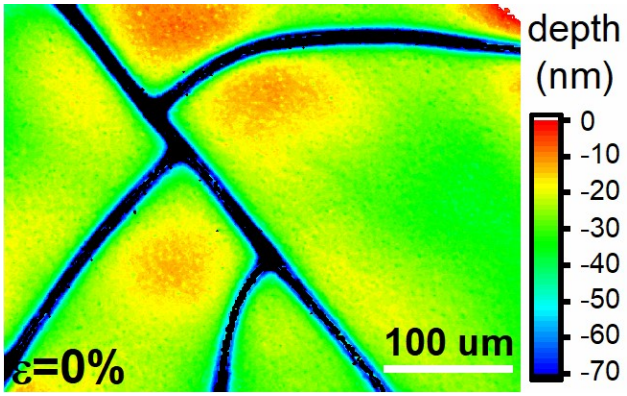

Figure S7. The surface topography of the 261 nm MgF_2-coated TPU measured at zero strain before application of strain. The scanned area is 400×300 μm.

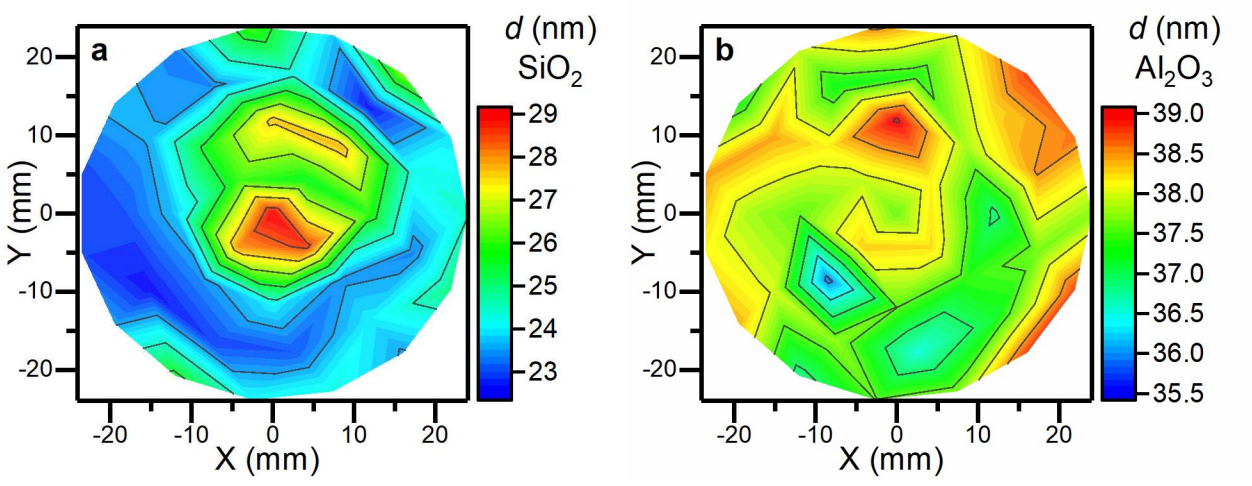

Figure S8. Thickness contour map of the (a) SiO_2 and (b) Al_2O_3 coatings on TPU, measured by ellipsometry. The mapped area is 18.1 cm^2.

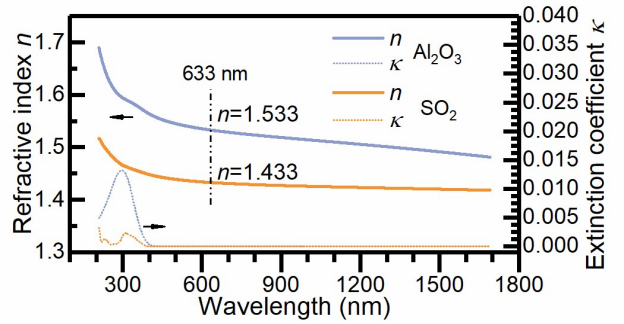

Figure S9. The complex refractive index of the (a) SiO_2 and (b) Al_2O_3 coating on the indicator Si wafer positioned next to the TPU substrate during the deposition.

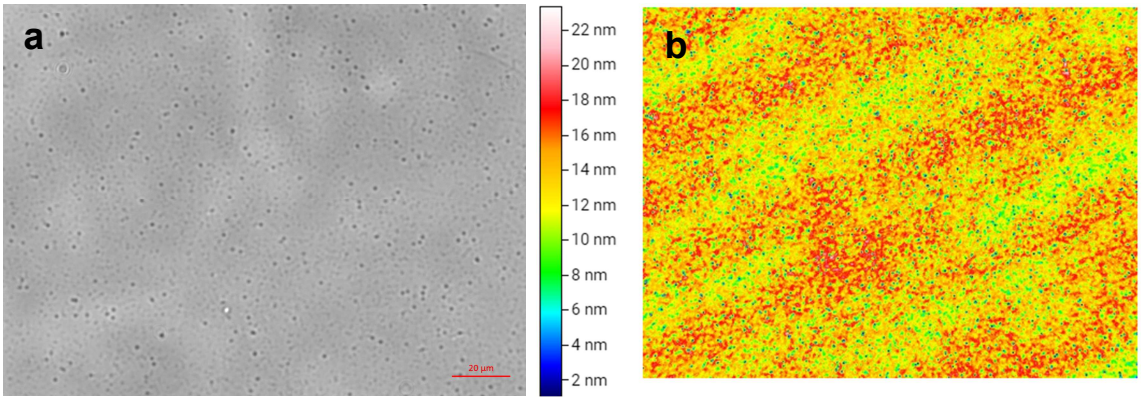

Figure S10. (a) Optical microscope image and (b) surface topography of bare TPU before coating. The roughness of bare TPU was determined to be 2.6 nm (root mean square). The profilometer scan area is 400×300 μm.

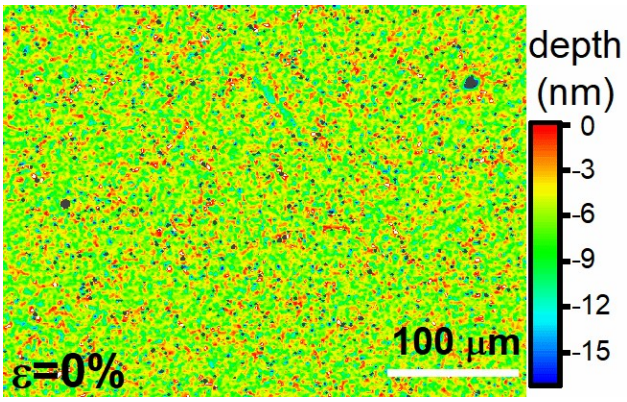

Figure S11. The surface topography of the two-layer polymer coating on TPU, measured in a state after the formation of the first cracks was detected. The scanned area is 400×300 μm.

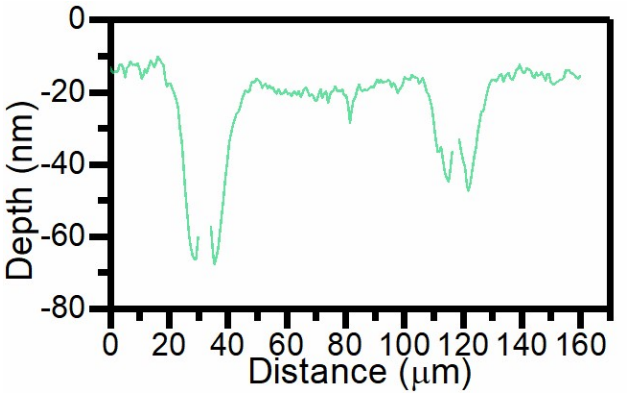

Figure S12. Depth profile of the 261 nm-MgF_2 coating measured along the same line indicated in Figure 5d. Measurement taken after first strain test with stress released to 0.3%.

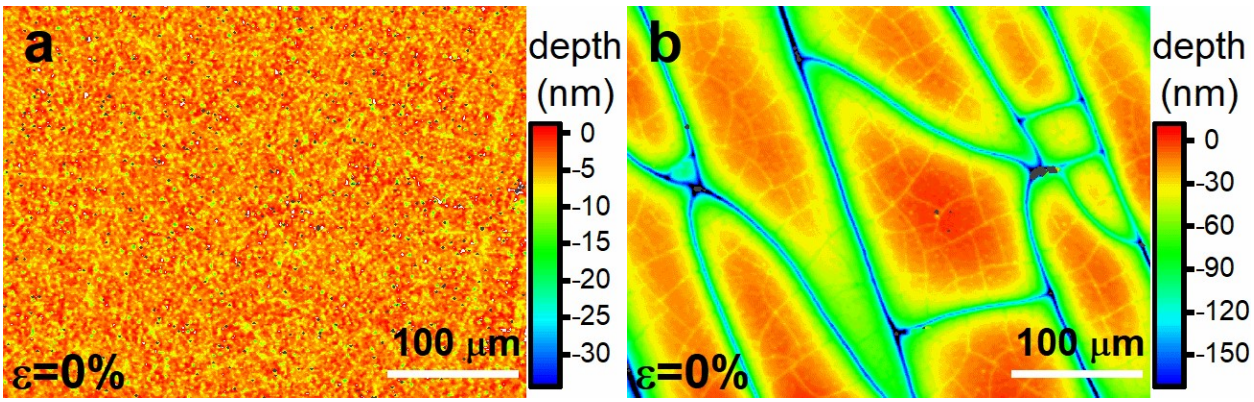

Figure S13. Surface topography of the (a) 25 nm-SiO_2 and (b) 38 nm-Al_2O_3 coatings on TPU, measured in the unstrained state after cracks first appeared. The scanned area is 400×300 μm.

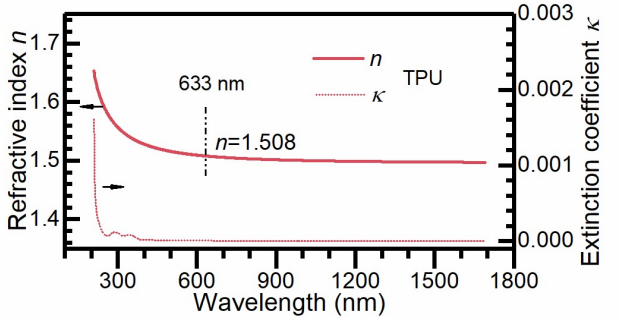

Figure S14. Complex refractive index by ellipsometry of the bare TPU.

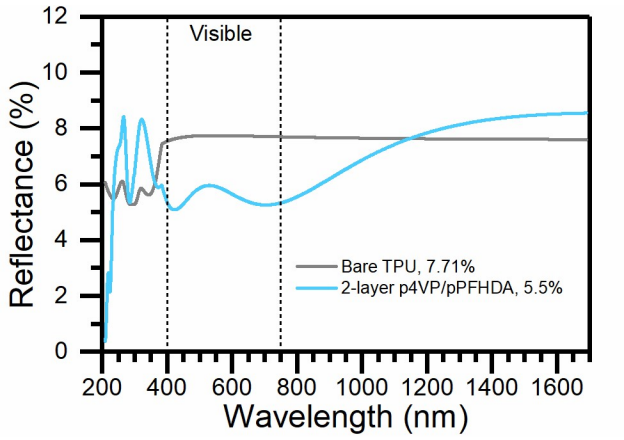

Figure S15. Calculated reflectance of bare TPU and polymer AR-coated TPU with backside reflection included. The numbers appearing in the legend are the average reflectance over the coating over visible wavelengths (400 – 750 nm).

Table S1. Layer structures of the designed AR coatings in the reflectance simulation

layer # from the substrate	2-layer p4VP/pPFHDA (This work)	6-layer p4VP/pPFHDA	2-layer p4VP/pPFDA
1	p4VP 163 nm	p4VP 187 nm	p4VP 159 nm
2	pPFHDA 96 nm	pPFHDA 22 nm	pPFDA 97 nm
3	-	p4VP 190 nm	-
4	-	pPFHDA 180 nm	-
5	-	p4VP 84 nm	-
6	-	pPFHDA 91 nm	-
Total thickness	259	754	256
Reflectance (Calculated on TPU)	1.8%	1.2%	0.8%

Deposition parameters of pPFDA

Chamber pressure: 1000 mTorr; monomer temperature: 25°C; substrate temperature: 20°C; Ar carrier gas flow for PFDA monomer: 50 sccm; initiator TBPO flow: 2 sccm; filament power: 46.5 W (0.7 A × 66.4 V)