Supplementary Material (ESI) for Soft Matter

Electronic Supplementary Information:

Thickness dependence of the elastic modulus of tris(8-hydroxyquinolinato) aluminum

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I. Wrinkling of Alq_3 deposited directly on PDMS

The Alq_3 deposited directly on PDMS diffuses into the PDMS, which impacts the wrinkle morphology. Figure S1 below illustrates the poorly defined wrinkle structure obtained in this case for Alq_3 on PDMS cured at 10:1 ratio. Using Figure S1, the meausred wavelength would lead to a modulus of approximately 0.07 GPa an order of magnitude lower than the actual value obtained when interdiffusion does not occur.

Figure S1. Optical micrograph of a wrinkled 36 nm thick Alq_3 film deposited directly on PDMS. The pre-strain for this system was 3 % and was released approximately 20 minutes after deposition.

II. Surface morphology of Alq_3 deposited on silicon wafers and PS/PDMS

Reports of substrate dependent moduli for Alq_3 do present potential for different morphologies to be present depending upon the substrate. To address if the deposition on a polymer is different from a hard substrate, AFM micrographs have been obtained for different Alq_3 film thicknesses on both silicon wafers and PS/PDMS stack that are analogous to those utilized for the wrinkling experiments, except no pre-strain is applied to the PDMS. Figure S2 below shows the relatively featureless surface morphology of the Alq_3 on both substrates. The RMS roughness of the surface increases by approximately a factor of 2 for the Alq3 deposited on the PS/PDMS. This is not unexpected due to the larger initial roughness induced by the PDMS (cast against float glass, which is rougher than polished silicon) and the spin coated PS film (RMS roughness is greater than for the vapor deposited Alq3 on the same silicon substrate).

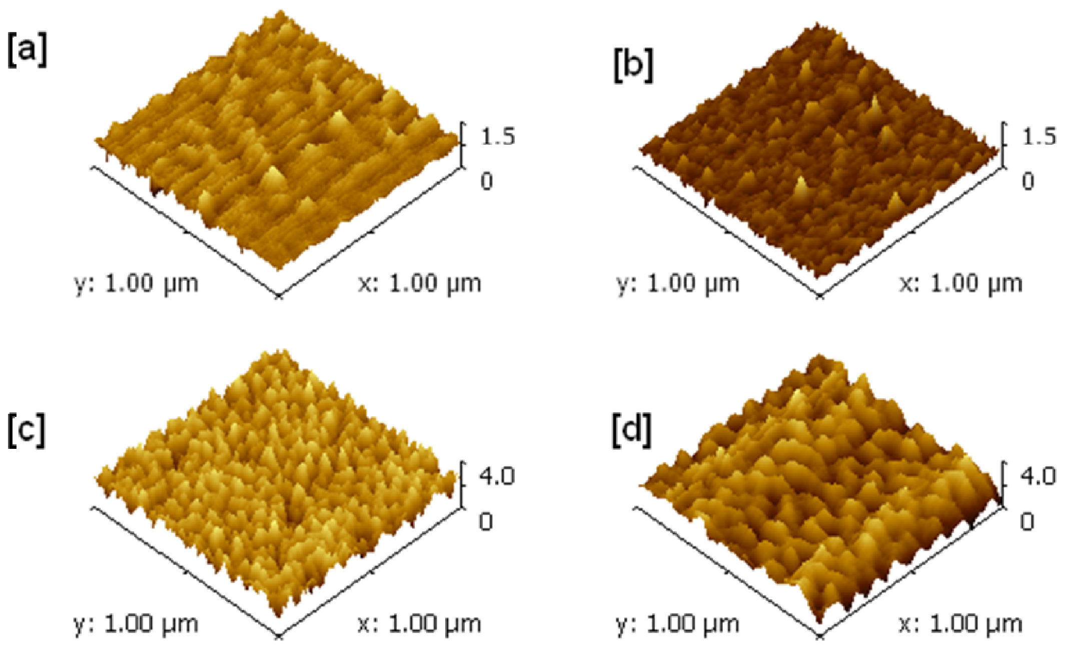

Figure S2. AFM images of Alq_3 for ca. 10 nm and 55 nm (from left to right) films deposited on silicon (a,b) and PS/PDMS (c,d).

III. Ellispometry fits of Alq_3/PS/PDMS and analogous Alq3 on silicon wafers

As each layer of the Alq_3/PS/PDMS stack is added sequentially, these layers are measured at each step in processing to additively build the SE model. First, the optical constants for the PDMS substrate are determined. A simple Cauchy model fits Δ and Ψ for the PDMS well; these constants for the PDMS are then held constant in subsequent fits. The optical constants for each batch of PDMS are however measured as there is sometimes a small batch to batch variation in the optical properties.

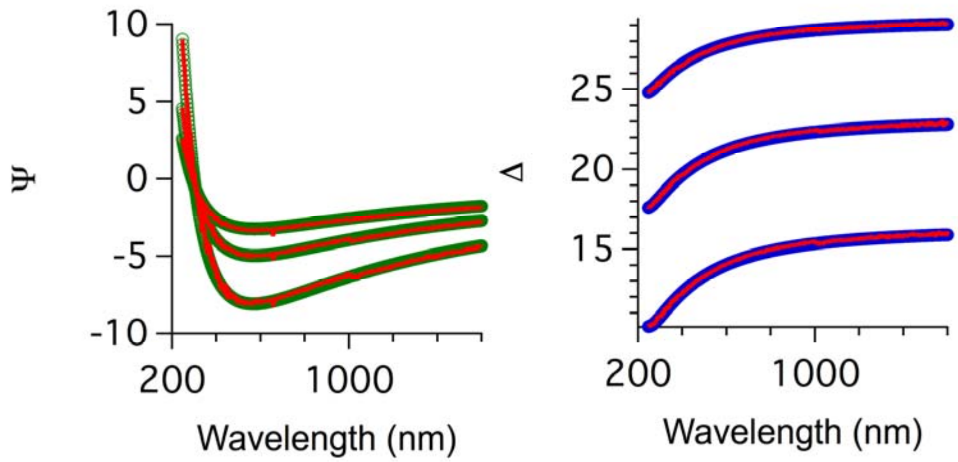

Figure S3. Representative ellipsometric data (o) and fits (solid lines) for PDMS.

Then the PS film is transferred to the PDMS. Using the optical constants for the PDMS and optical constants obtained for thick PS films (from Cauchy model), the thickness of the PS film is fit. As the PS is glassy at ambient, the thickness of the PS is assumed to remain constant.

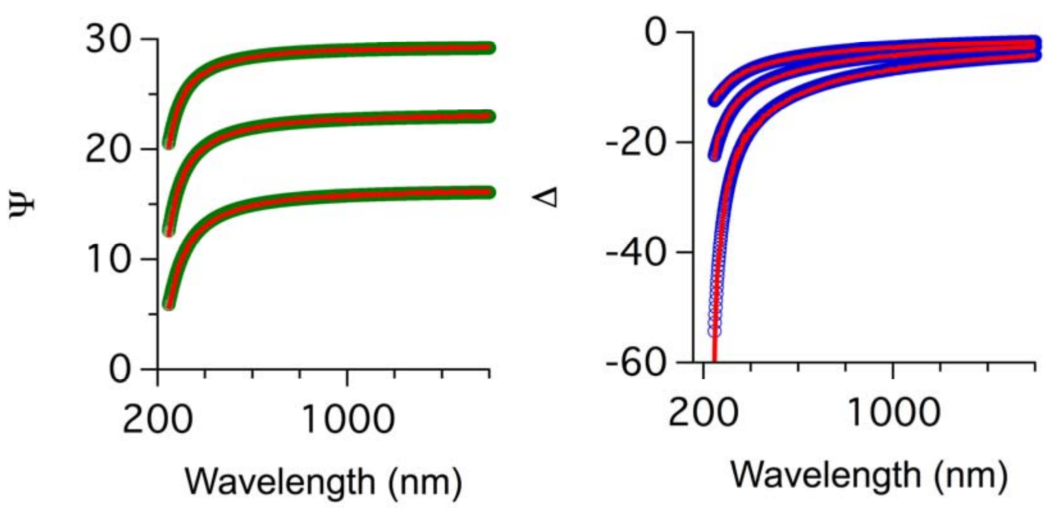

Figure S4. Representative ellipsometric data (o) and fits (solid lines) for PS on PDMS.

After vapor deposition of the Alq_3, the thickness and optical constants for the Alq3 in the transparent region (600-1600 nm) are determined by fitting Δ and Ψ using a Cauchy dispersion model. The thickness of the Alq_3 is then fixed and the optical constants through the whole measured wavelength range (250-1600 nm) are fit using Lorentz oscillators to insure Kramer-Kronig consistency of the determined optical constants. Then the oscillators and thickness are allowed to float to provide a best fit of the Alq_3 layer (< 1 nm change in thickness is generally observed).

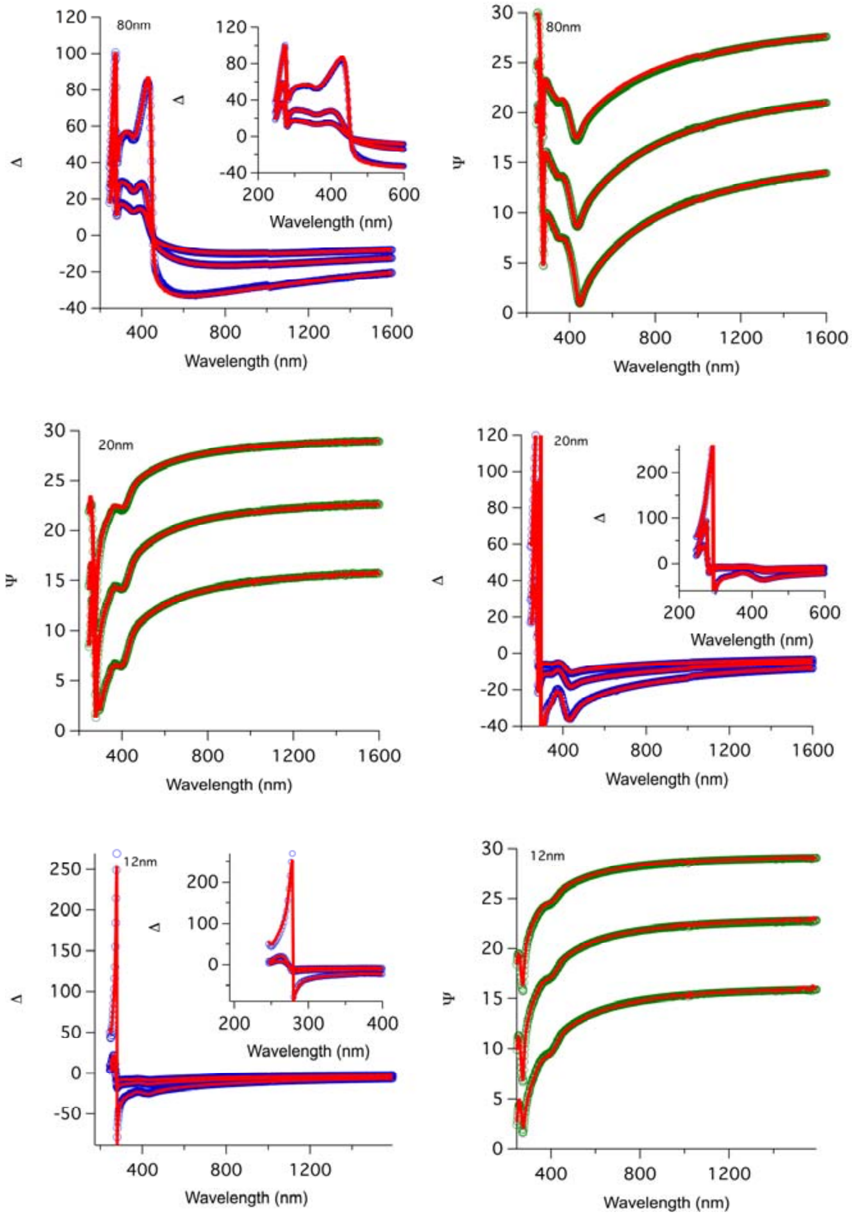

Figure S5. Representative ellipsometric data (o) and fits (solid lines) for Alq_3 on PS on PDMS.

From the best fits of the ellipsometric data, the optical constants and thickness of the Alq_3 films are obtained. We have also measured and fit Alq_3 films deposited on silicon wafers as well to determine if there is a difference in morphology that manifests itself in the optical properties. Shown in Figure S6, the optical constants determined from spectroscopic ellipsometry are similar for Alq_3 irrespective of substrate. There is a slight offset in *n* for the thinnest films due to a coupling between thickness and refractive index, but this does not significantly impact the *k* for these films obtained from fitting of the spectroscopic ellipsometry data.

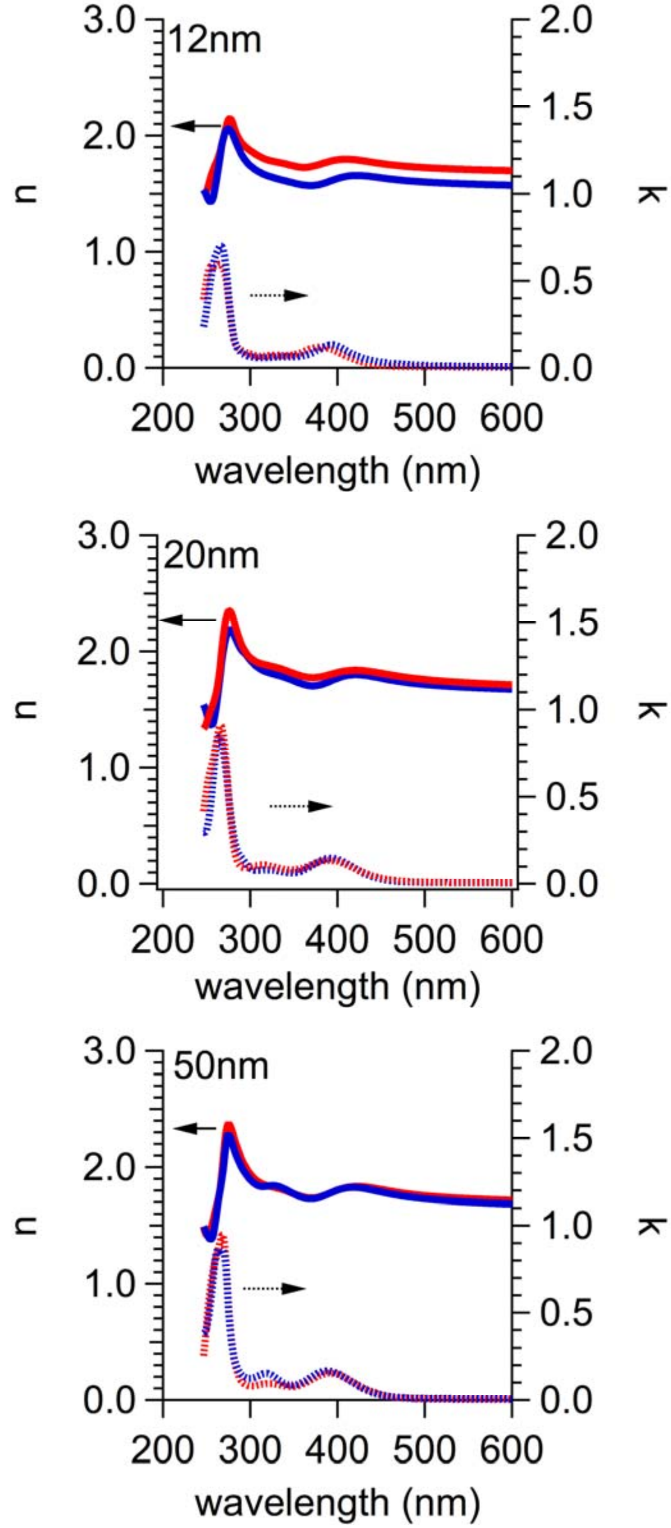

Figure S6. Refractive index n and extinction coefficient k obtained from the ellipsometric spectra for 12nm, 20nm, and 50nm Alq_3 on Si (red, circles) and PS/PDMS (blue, lines)