Electronic Supplementary Material (ESI) for Energy & Environmental Science.

Supplementary Information

Bright, wind-driven white mechanoluminescence from zinc sulphide microparticles embedded in a polydimethylsiloxane elastomer

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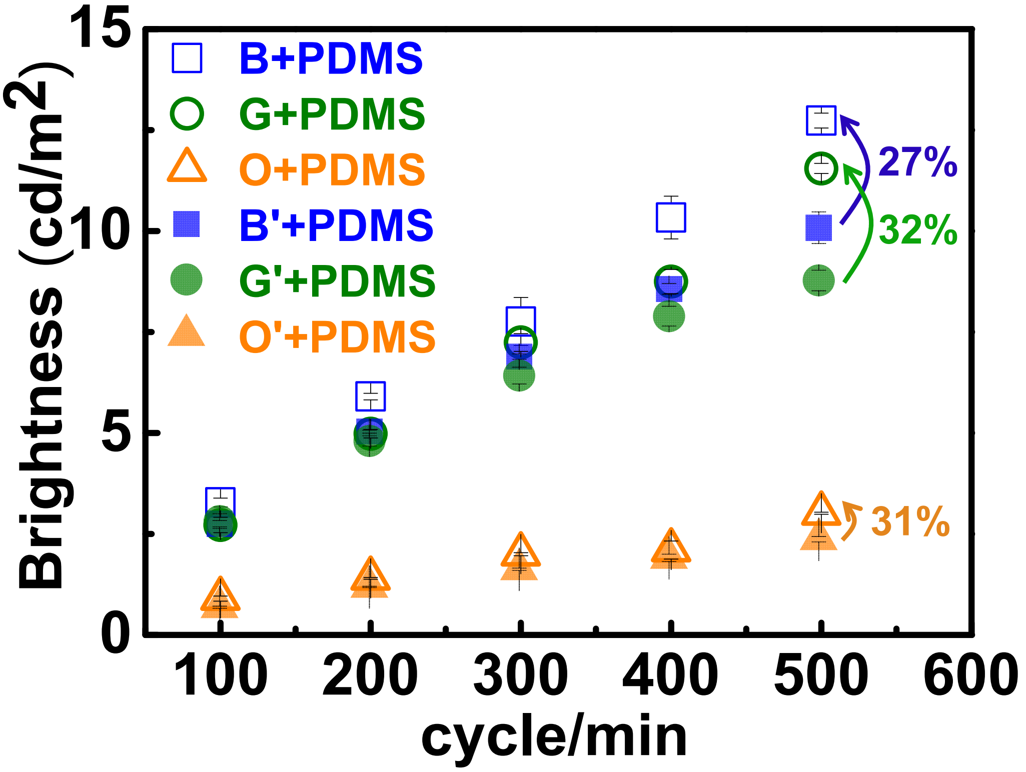

Fig. S1. ML brightness of various samples. The samples compared are the B+, G+, and O+PDMS samples (blue, GG64; green, GG45; and orange, GG13, purchased from Osram Sylvania Inc.) and the B’, G’, and O’ materials from previous studies (blue, GGS62; green, GGS42; and orange, GGS12, purchased from Osram Sylvania Inc.). Note that the current materials are approximately 20–30% brighter at the 500-cpm S-R rate.

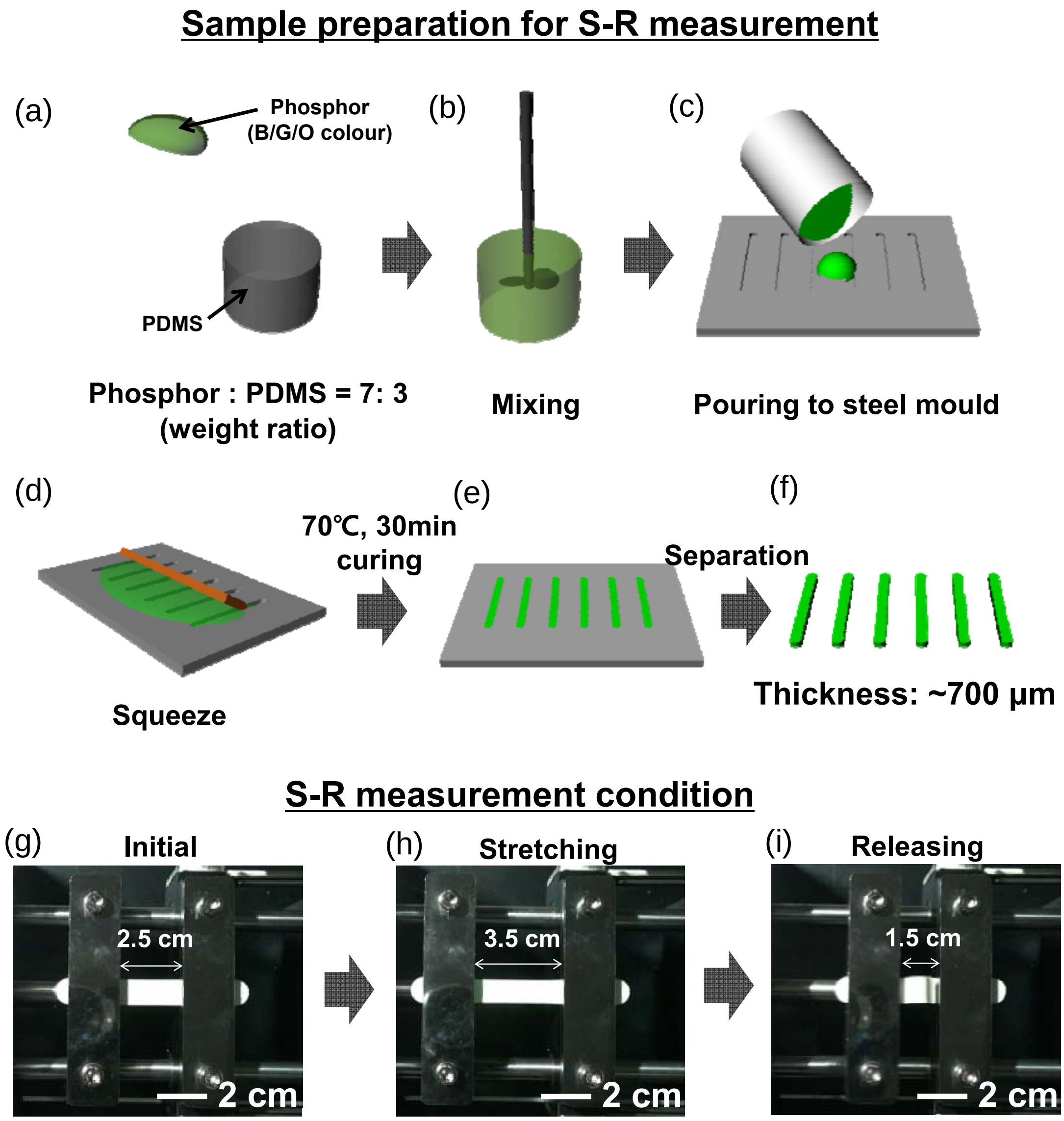

Fig. S2. Schematic illustration of the sample preparation and measurement conditions for the S-R test. (a) Mixed or unmixed (i.e., pure) phosphors were poured into a PDMS solution and (b) mixed well. (c) This mixed solution was poured into a steel mould, which acted as a template. After (d) squeezing, (e) the solution was cured at 70°C for 30 min. (f) The ML composites for the S-R measurement were prepared by separating the ML from the steel mould. To take the S-R measurement, (g) the sample was mounted onto the S-R system without any deformation (2.5 cm). The sample was then (h) mechanical stretched (3.5 cm) and (i) released (1.5 cm) . The S-R process shown in (h) and (i) is defined as 1 cycle.

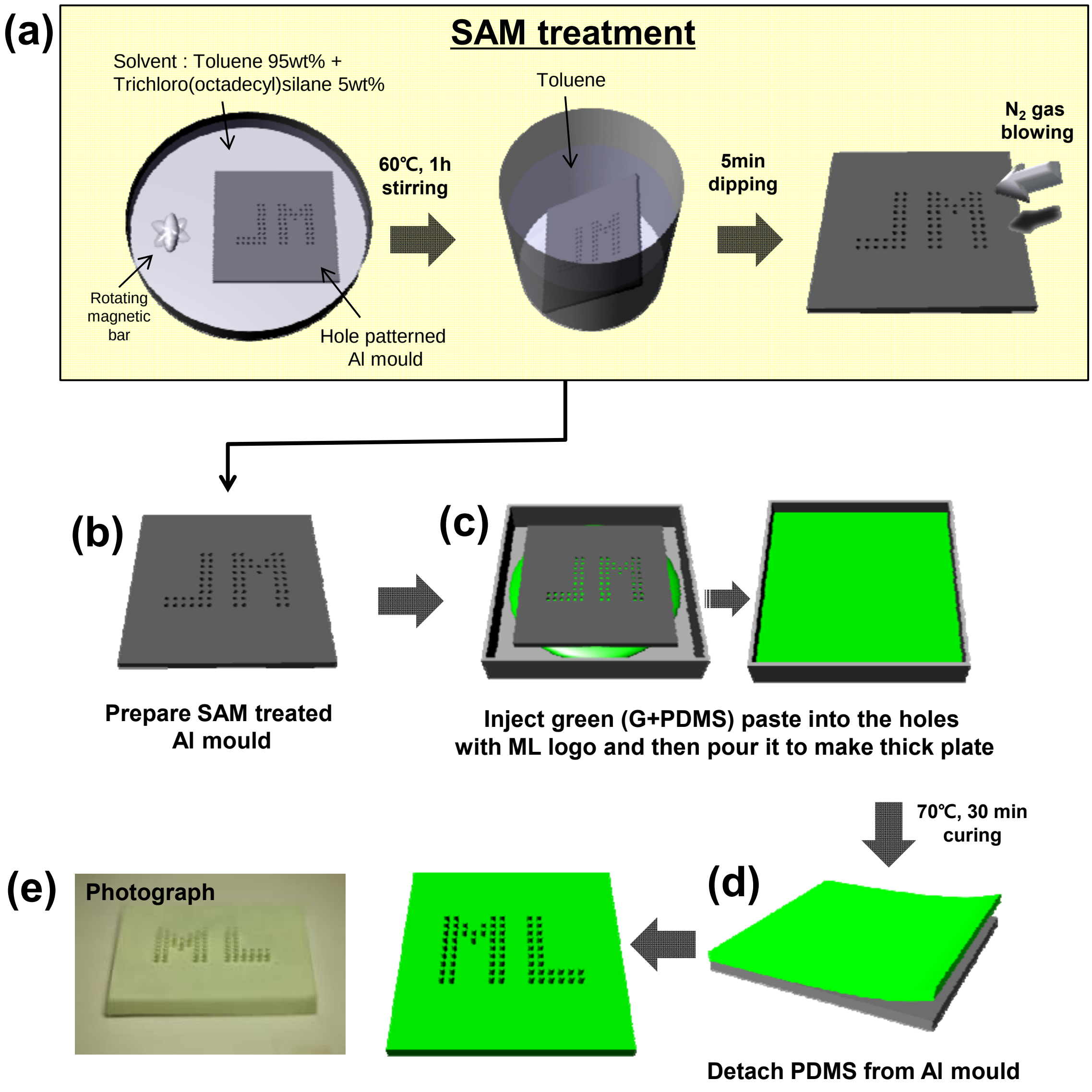

Fig. S3. Schematic of the fabrication process used to produce the wind-driven patterned ML sample with only a green "ML." (a) SAM surface treatment of the Al mould with "ML" patterned holes using a mixed solvent of toluene (95 wt%) and trichloro(octadecyl)silane (5 wt%). (b–c) Injection of green (G+PDMS) paste into the holes defining the ML logo, followed by pouring to make a thick plate. (d–e) After curing (at 70°C for 30 minutes), the PDMS is separated from the Al mould.

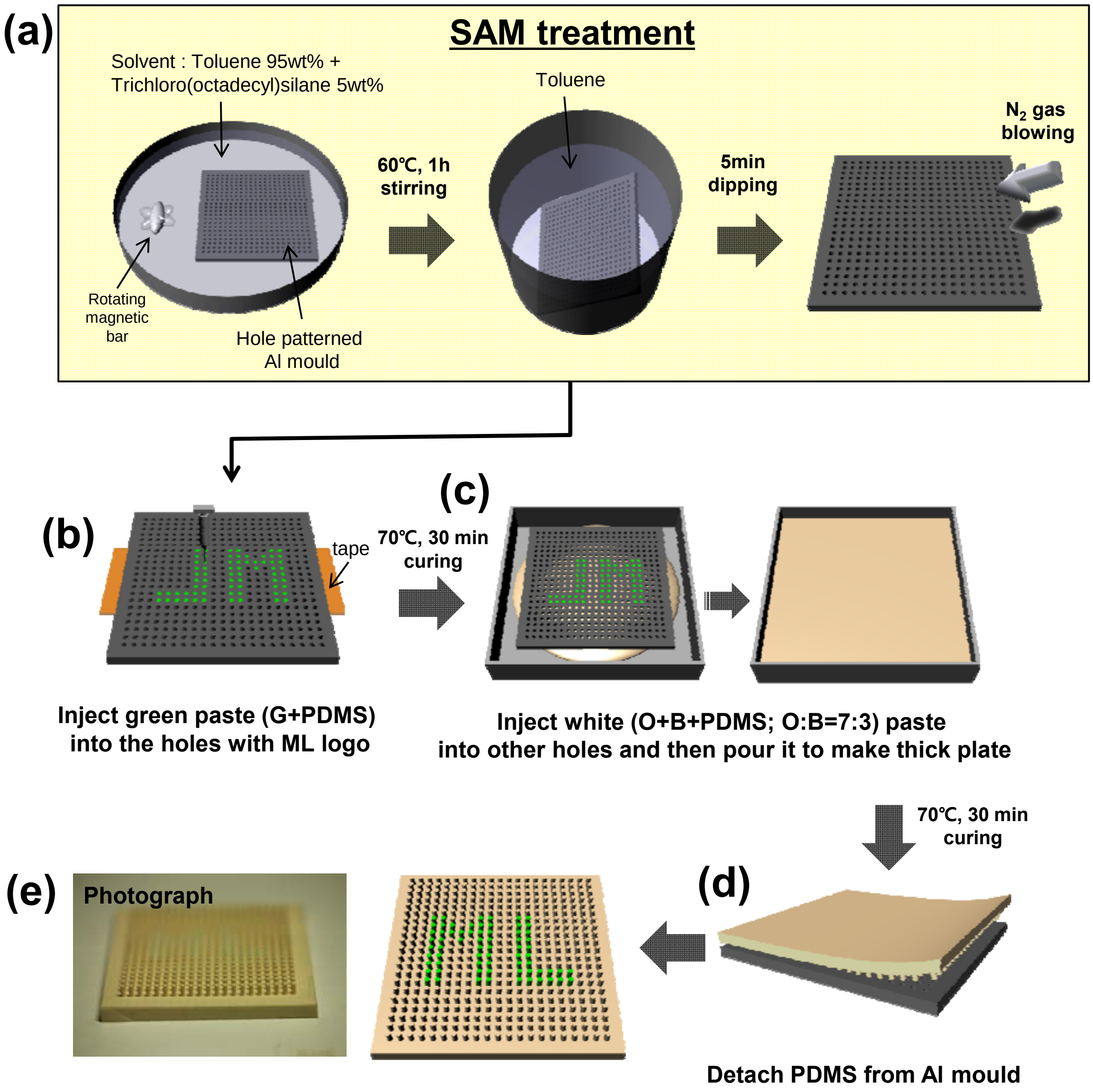

Fig. S4. Schematic of the fabrication process used to produce the wind-driven patterned ML sample with a green "ML" and white background. (a) SAM surface treatment of the Al mould with "ML" patterned holes using a mixed solvent of toluene (95 wt%) and trichloro(octadecyl)silane (5 wt%). (b) Injection of green (G+PDMS) paste into the holes defining the ML logo. (c) Injection of white (O+B+PDMS; O:B=7:3) paste into the remaining holes, followed by pouring to make a thick plate. (d–e) After curing (at 70°C for 30 minutes), the PDMS is separated from the Al mould.

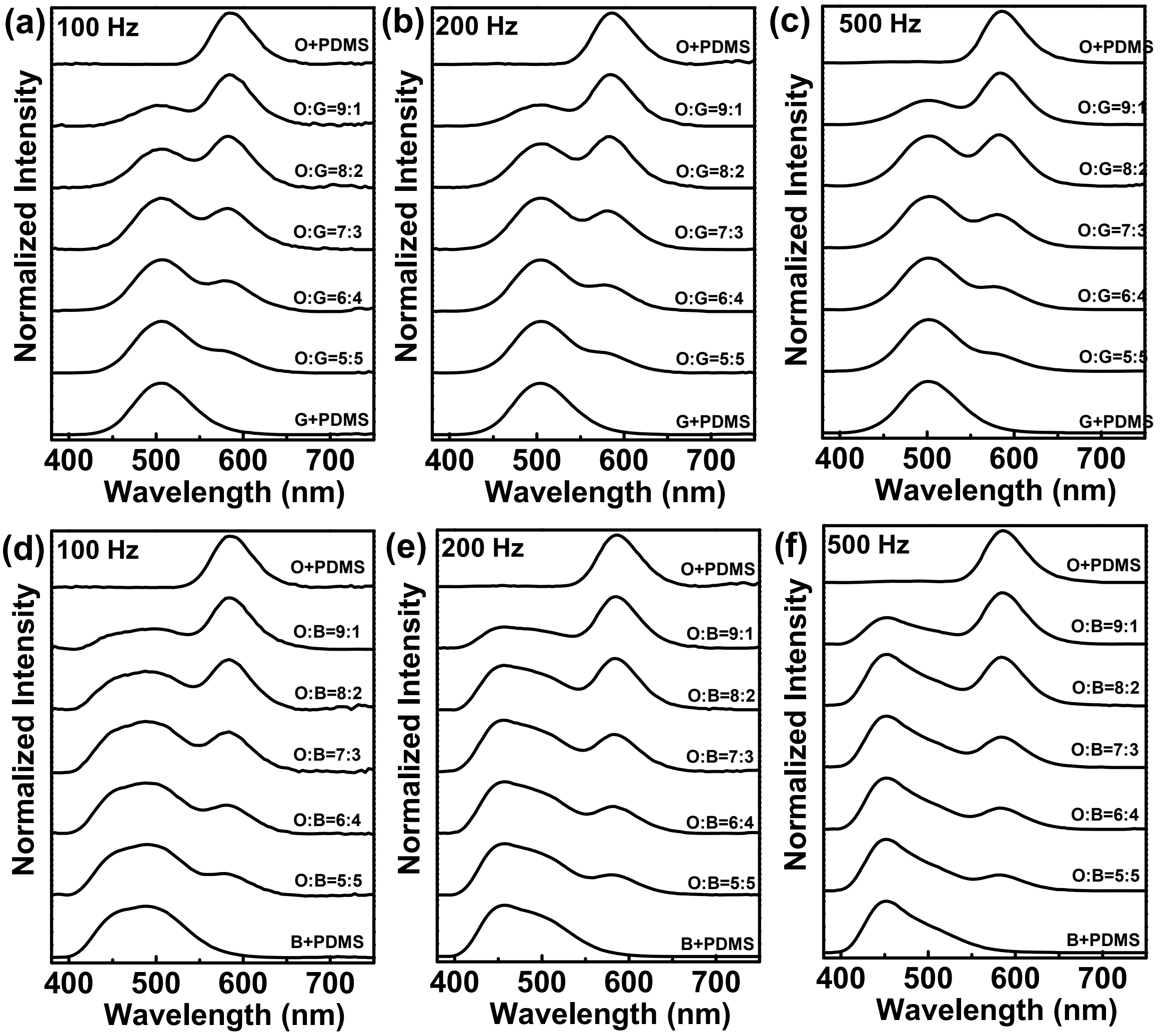

Fig. S5. EL spectra of the O+G+PDMS and O+B+PDMS samples with various mixing ratios at (a, d) 100 Hz, (b, e) 200 Hz, and (c, f) 500 Hz.

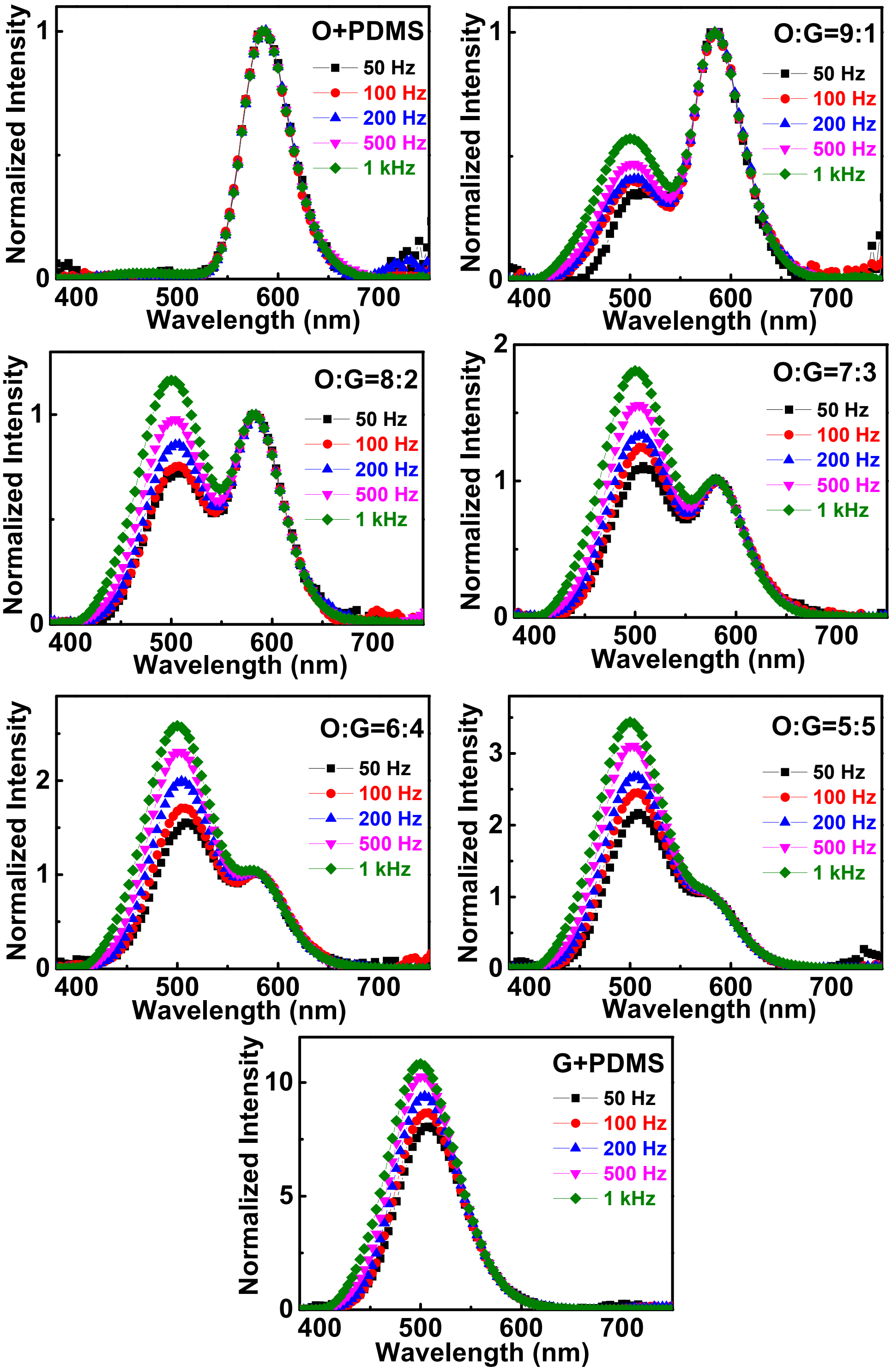

Fig. S6. Calculated EL intensity normalised to 586 nm in the O+G+PDMS ACEL samples with various mixing ratios.

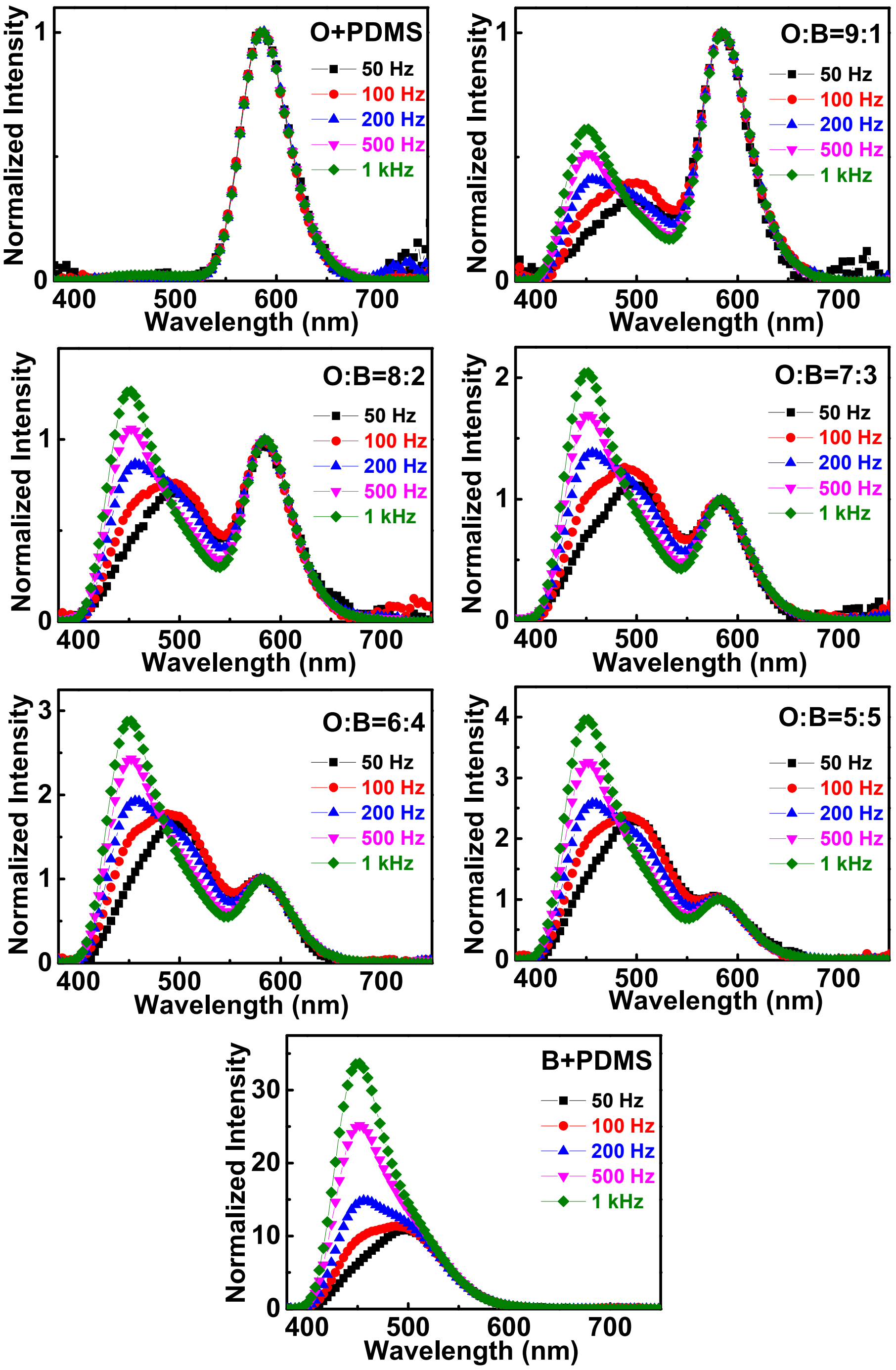

Fig. S7. Calculated EL intensity normalised to 586 nm in the O+B+PDMS ACEL samples with various mixing ratios.

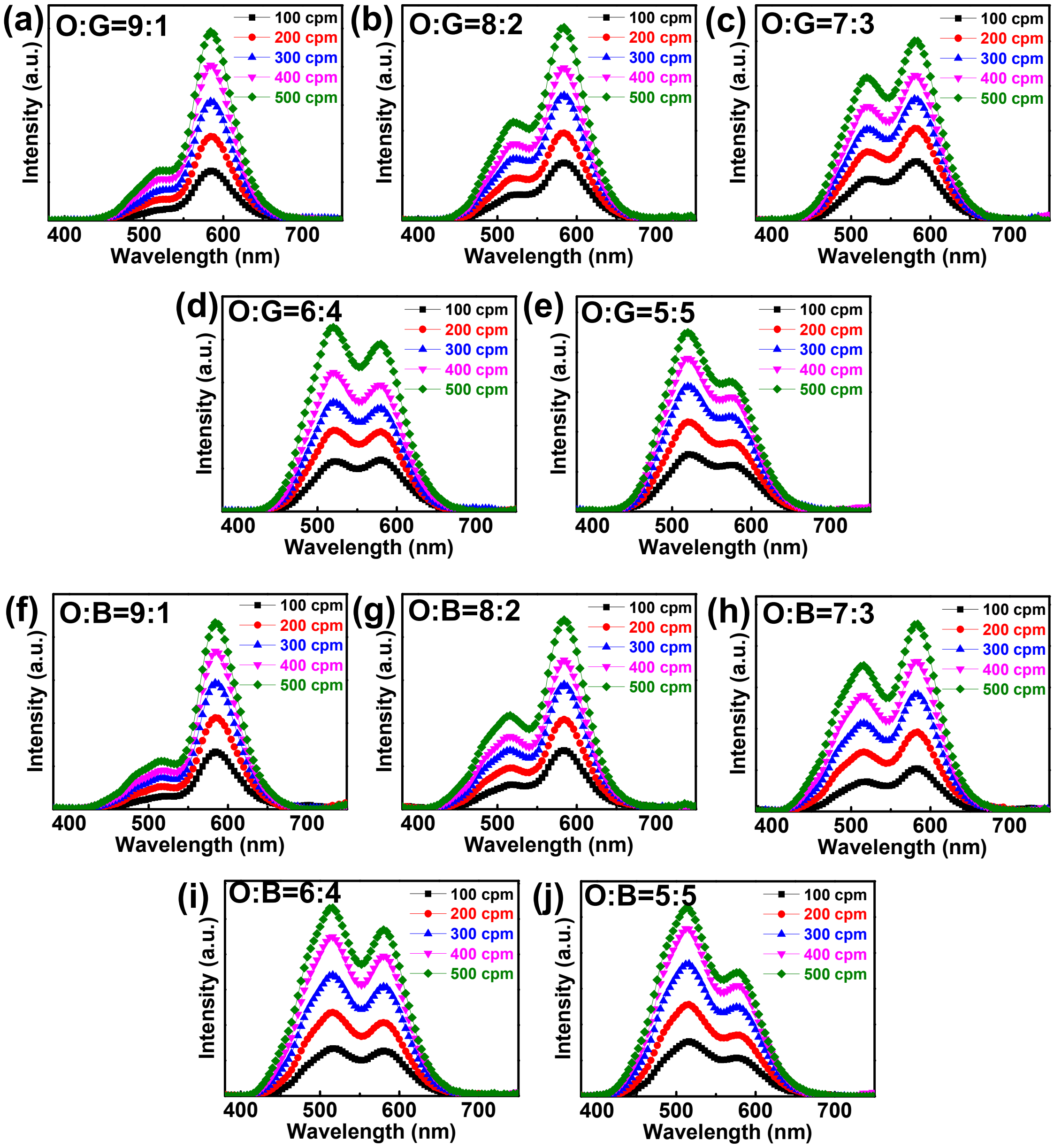

Fig. S8. ML spectra obtained from O+G+PDMS (a-e) and O+B+PDMS (f-j) samples with various mixing ratios. The S-R rates were varied from 100 to 500 cpm in 100-cpm increments.

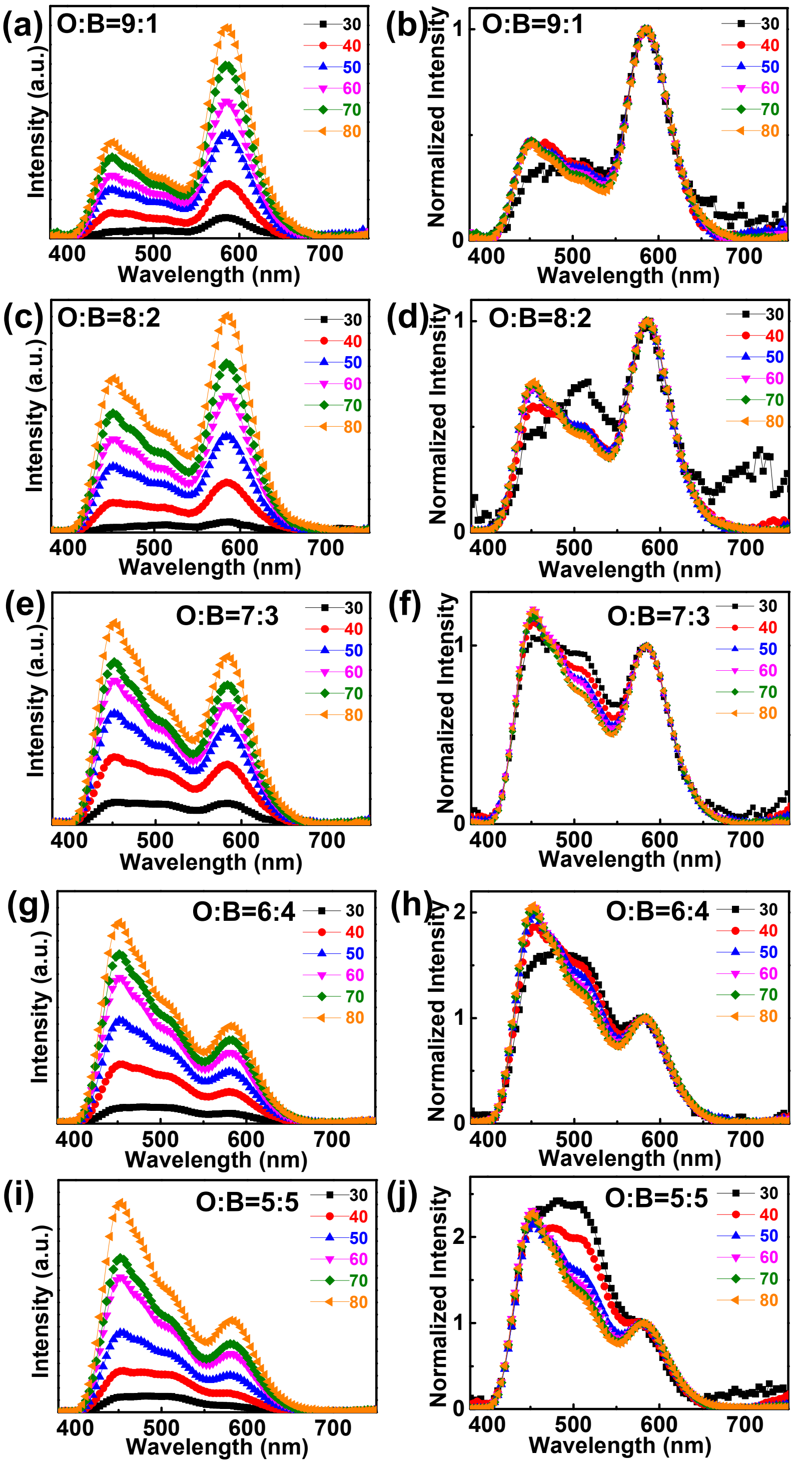

Fig. S9. Wind-driven ML spectra obtained from O+B+PDMS. (a, c, e, g, i) Intensity plotted as a function of wavelength. (b, d, f, h, j) Intensity normalised to 586 nm plotted as a function of wavelength.