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All-Polymer Lasers YEHENG WU, JOSEPH LOTT, TOMASZ KAZMIERCZAK, HYUNMIN SONG, ERIC BAER, KENNETH SINGER, CHRISTOPH WEDER, ORGANIC OPTOELECTRONICS TEAM, CENTER FOR APPLIED POLYMER RESEARCH TEAM, FUNCTIONAL POLYMER TEAM — We have fabricated all-polymer lasers both as distributed feedback lasers (DFB) and distributed Bragg reflector (DBR) lasers. For the DBR lasers, a layer of polymer doped with the laser dye is laminated between two multilayer polymer mirrors. The mirrors were made using the co-extrusion process combining PMMA alternated with polystyrene with 128 layers for each mirror. Two dyes were employed, Rhodamine 6G (R6G), and 1,4-bis-(α-cyano-4-methoxystyryl)-2,5-dimethoxybenzene (C1RG). They were pumped with a nanosecond laser and emitted at about 570 and 510 nm respectively. For DFB lasers, the low refractive index layers were doped with C1RG or R6G. PMMA and PMMA-PVDF were the hosts for the C1RG and R6G respectively. A total of eight co-extruded 32-layer films were stacked together to make a DFB laser. For the DBR lasers, we were able to observe thresholds as low as 100nJ. The highest conversion efficiency obtained about 14% in the forward direction. We also observed trends of lasing threshold, even spaced lasing modes and penetration of the film. Matrix method simulations taking into account layer thickness variations were consistent with experimental results. For the DFB lasers, the lowest lasing threshold observed was 52 μW.

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