

Organic copolymer lasing from single defect microcavity fabricated using laser patterning

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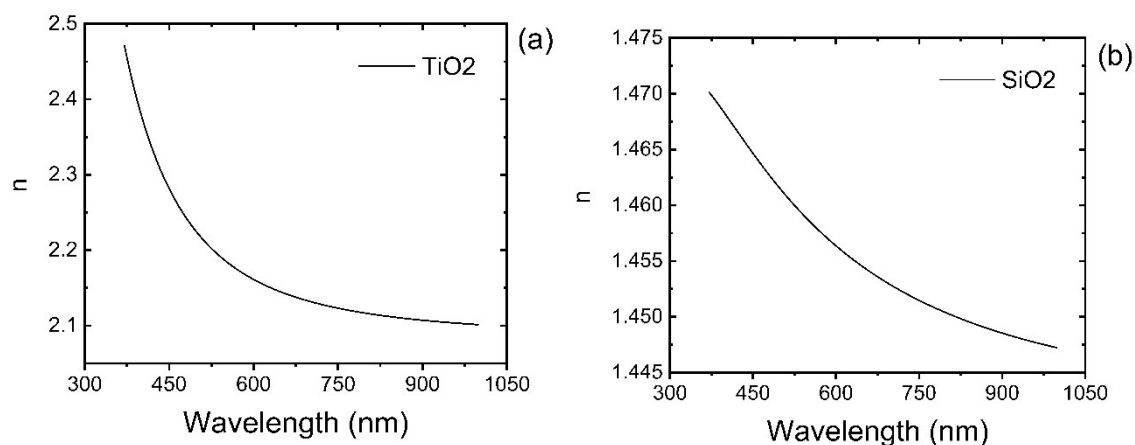


Figure 1: Refractive index measured using ellipsometry of (a) TiO₂ (b) SiO₂

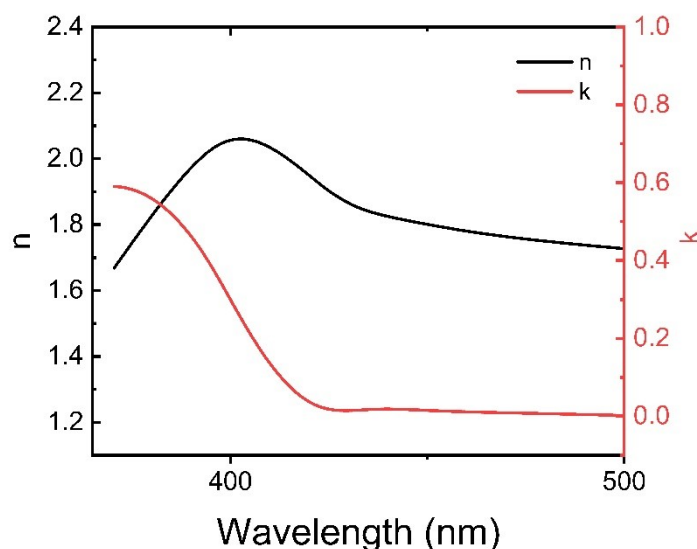


Figure 2: Optical constants measured using ellipsometry for BN-PFO with 12.7% BN content

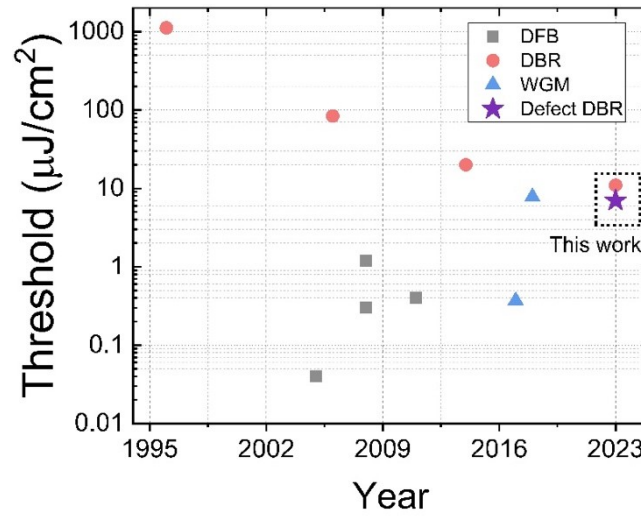


Figure 3: Polymer laser threshold comparison for DFB (Grey Square), DBR (red circle), WGM (Blue triangle), and defect cavity (purple star). The dashed square outline the thresholds measured in this study.

	Lasing threshold ($\mu\text{J}/\text{cm}^2$)			
Microcavity	1120 ¹	84 ⁴	20 ⁷	11 (this work)
DFB	1.2 ²	0.4 ⁵	0.3 ⁸	0.04 ⁹
WGM	7.8 ³	0.37 ⁶		
Defect DBR	7 (this work)			

Table 1: Polymer laser thresholds referred to in Figure 3

- 1 G. J. Denton, R. H. Friend, N. Tessler, *Nature*, 1996, **382**, 695–697.
- 2 T. Wellinger, C. Pflumm, J. Becker, T. Weimann, M. Campoy-Quiles, P. N. Stavrinou, U. Scherf and D. D. C. Bradley, *Org. Optoelectron. Photonics III*, 2008, **6999**, 699907.
- 3 S. J. Tang, Z. Liu, Y. J. Qian, K. Shi, Y. Sun, C. Wu, Q. Gong and Y. F. Xiao, *Adv. Mater.*, 2018, **30**, 1–7.
- 4 L. Persano, P. Del Carro, E. Mele, R. Cingolani, D. Pisignano, M. Zavelani-Rossi, S. Longhi and G. Lanzani, *Appl. Phys. Lett.*, DOI:10.1063/1.2179611.
- 5 A. J. C. Kuehne, M. Kaiser, A. R. MacKintosh, B. H. Wallikewitz, D. Hertel, R. A. Pethrick and K. Meerholz, *Adv. Funct. Mater.*, 2011, **21**, 2564–2570.
- 6 S. Kushida, D. Okada, F. Sasaki, Z. H. Lin, J. S. Huang and Y. Yamamoto, *Adv. Opt. Mater.*, 2017, **5**, 1–7.
- 7 G. Canazza, F. Scotognella, G. Lanzani, S. De Silvestri, M. Zavelani-Rossi and D. Comoretto, *Laser Phys. Lett.*, DOI:10.1088/1612-2011/11/3/035804.
- 8 B. K. Yap, R. Xia, M. Campoy-Quiles, P. N. Stavrinou and D. D. C. Bradley, *Nat. Mater.*, 2008, **7**, 376–380.
- 9 A. Rose, Z. Zhu, C. F. Madigan, T. M. Swager and V. Bulović, *Nature*, 2005, **434**, 876–879.