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Coherence properties of a single-mode polariton laser SEONGHOON KIM, BO ZHANG, ZHAORONG WANG, HUI DENG, Univ of Michigan - Ann Arbor, JULIAN FISCHER, SEBASTIAN BRODBECK, MARTIN KAMP, CHRISTIAN SCHNEIDER, Univ of Wuerzberg, SVEN HOFLING, Univ of Wuerzberg, Univ of St Andrews, UNIV OF MICHIGAN - ANN ARBOR COLLABORATION, UNIV OF WUERZBERG COLLABORATION — Exciton-polariton condensation is a promising low threshold coherent light source, namely a polariton laser. However, first- and second-order coherences of a polariton laser has been poor and not well understood in two dimensional microcavity systems. Here, we show experimentally that full second-order coherence is established in a single-mode polariton laser and maintained far above the lasing threshold. The coherence time of first-order coherence functions increases initially and then reduces as the number of polaritons in a ground state increases due to the polariton-polariton interaction. Moreover, a transition in spectral lineshape from Lorentzian to Gaussian was observed as the occupation number increases as a result of the large interaction energy. These results are in very good agreement with a single-mode atom laser theory. The single-mode polariton laser was realized by designing a subwavelength grating (SWG) mirror which provides strong lateral confinement for discrete polariton states and polarization-selective reflectance for lifted spin-degeneracy. The results would be important for making fully coherent polariton lasers, as well as nonlinear polariton devices.

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