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Bulk InAlAs(111)A as a novel material system for pure, single photon emission PAUL J. SIMMONDS, Boise State University, S. UNSLEBER, M. DEPPISCH, M. VO, C. SCHNEIDER, Universität Würzburg, S. HÖFLING, Universität Würzburg / University of St Andrews, C. M. KRAMMEL, P. M. KOENRAAD, Eindhoven University of Technology, C. D. YERINO, Yale University, M. L. LEE, Yale University / UIUC — Certain protocols for quantum cryptography rely on a single photon source.[1] Semiconductor quantum dots (QDs) are an attractive candidate for single photon generation: QDs can be incorporated into scalable cavity/waveguide structures, and QD quantum key distribution has already been demonstrated.[2] Growth of III-V QDs is well established, but very close control is required. QD density/size are dramatically affected by small changes in growth parameters, which is a challenge for QD uniformity. In contrast, we present a material system with a remarkably straightforward growth process, which delivers single photon emission. We see spectrally sharp emission lines from bulk InAlAs grown on InP(111)A. Via cross-sectional STM and $k \cdot p$ simulations, we identify excitons in indium-rich nanoclusters as the origin of these spectral features. In-rich regions form spontaneously during growth via nanoscale InAlAs phase-segregation. Nanocluster emission has median linewidth 137 eV, and fine structure splitting 28 eV. We confirm on-demand emission of pure, single photon emission, with 2nd-order correlation values $g^{(2)} = 0.05^{+0.17}_{-0.05}$ (CW), and 0.24 ± 0.02 (triggered).

[1]Shields, Nat. Phot. 1, 215 (2007)
[2]Rau et al., New J. Phys. 16, 043003 (2014)

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