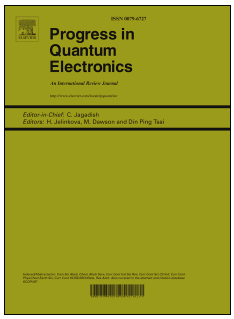
Accepted Manuscript



Diamond Photonics for Distributed Quantum Networks

Sam Johnson, Philip R. Dolan, Jason M. Smith

PII: S0079-6727(17)30016-2

DOI: 10.1016/j.pquantelec.2017.05.003

Reference: JPQE 202

To appear in: *Progress in Quantum Electronics*

Please cite this article as: S. Johnson, P.R. Dolan, J.M. Smith, Diamond Photonics for Distributed Quantum Networks, *Progress in Quantum Electronics* (2017), doi: 10.1016/j.pquantelec.2017.05.003.

Diamond Photonics for Distributed Quantum Networks

Sam Johnson, Philip R. Dolan and Jason M. Smith

Department of Materials, University of Oxford, Parks Road, Oxford, OX1 3PH

Abstract

The distributed quantum network, in which nodes comprising small but well-controlled quantum states are entangled via photonic channels, has in recent years emerged as a strategy for delivering a range of quantum technologies including secure communications, enhanced sensing and scalable quantum computing. Colour centres in diamond are amongst the most promising candidates for nodes fabricated in the solid-state, offering potential for large scale production and for chip-scale integrated devices. In this review we consider the progress made and the remaining challenges in developing diamond-based nodes for quantum networks. We focus on the nitrogen-vacancy and silicon-vacancy colour centres, which have demonstrated many of the necessary attributes for these applications. We focus in particular on the use of waveguides and other photonic microstructures for increasing the efficiency with which photons emitted from these colour centres can be coupled into a network, and the use of microcavities for increasing the fraction of photons emitted that are suitable for generating entanglement between nodes.

Keywords: Diamond photonics, Quantum networks, Color centers, Nitrogen-vacancy, Silicon-vacancy, Microcavities

Contents

Email address: sam.johnson@materials.ox.ac.uk (Sam Johnson, Philip R. Dolan and Jason M. Smith)