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Abstract for an Invited Paper  
for the MAR14 Meeting of  
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**Quantum Hybrid Systems: New Interface between Quantum Optics and Nanoscience**

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We will discuss recent developments involving the use of quantum optical techniques in a combination with nanoscale localization of light and atoms inside or near solid-state systems. Specially, realization of quantum optical phase switch operating at a single photon level will be presented. In addition, new applications involving nanoscale magnetic and temperature sensing in living cells will be discussed.