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SINCE MMXV



MRS/E-MRS Joint Student Chapter, Hasselt University  
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## 2018 Materials Science Lecture series: ADVANCED MATERIALS

### Quantum sensing based on single atomic probes in solids



#### SPEAKER:

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#### CHAired BY:

Prof. Dr. Milos Nesladek

#### WHEN ?

9<sup>th</sup> July 2018  
(Monday),  
10.45-12.20h

#### WHERE ?

H4, Building D  
Campus  
Diepenbeek  
Hasselt University

Quantum sensing utilizes unique properties of quantum systems for ultrasensitive detection. Different from quantum computation and simulation, quantum sensing requires much less resources and number of qubits, thus becomes highly promising to be practically applicable in the near future. We focus on detecting nanoscale magnetic and electric fields using single atomic defects in solids as quantum sensors. In the first part of this report, we will introduce our works on quantum control over single NV center in diamond [1], and make it as an atomic probe to detect the magnetic resonance spectroscopy of single spin-labeled protein under ambient conditions [2]. We measure the orientation of the spin label at the protein and detect the impact of protein motion on the spin label dynamics. In the second part, based on hybrid optical-electrical detection method, we use single rare-earth ions ( $\text{Er}^{3+}$ ) in silicon as atomic probe to detect the electric field and strain in the channel of nano-transistors. Strain change of smaller than  $3 \times 10^{-6}$  are detected, which is around two orders of magnitude more sensitive than the standard techniques used in the semiconductor industry [3].

[1] W. Ma\*, L. Zhou\*, **Q. Zhang\*** et al., PRL 120, 120501 (2018)

[2] F. Shi\*, **Q. Zhang\***, P. Wang\* et al., Science 347, 1135 (2015)

[3] **Q. Zhang\***, G. Hu\* et al., arXiv:1803.01573 (2018)

The lecture is supported by :

