SERS Microscopy: Tissue Diagnostics with Rationally Designed Nanoparticle Probes

S. Schlücker, M. Salehi, M. Schütz

University of Duisburg-Essen, Physical Chemistry, D-45141 Essen, Germany
sebastian.schluecker@uni-due.de

Surface-enhanced Raman scattering microscopy (µSERS) [1] employs target-specific colloidal SERS probes in combination with Raman microspectroscopy. For example, SERS-labeled antibodies allow the selective and sensitive localization of the corresponding antigen in tissue specimens [2].

The physical and chemical properties of the colloidal SERS probes are crucial for the success of SERS microscopic experiments [3]. Stability and robustness, sensitivity as well as steric accessibility for bioconjugation are few very important aspects. Figure 1 left shows a hydrophilic SERS probe stabilized by many short and few longer hydrophilic spacer units [4]. A second approach, based on the glass encapsulation for stabilizing SERS labels, is schematically depicted in Figure 1 right. This type of SERS probes was optimized for red laser excitation in order to improve image contrast by minimizing unwanted autofluorescence of biological specimens [5]. Two different routes to the glass encapsulation of a complete monolayer of Raman reporters will be described [5-6]. Small clusters (dimers, trimers) of gold nanocrystals even exhibit single-particle sensitivity and enable rapid mapping experiments with only 30 msec acquisition time per pixel [7]. Future directions of this innovative Raman/SERS microspectrosopic technique for tissue-based tumor diagnostics will be discussed.

References

[1] S. Schlücker, *ChemPhysChem* **10** (2009) 1344-1354.
[2] S. Schlücker, B. Küstner, A. Punge, A. Marx, P. Ströbel, *J. Raman Spectrosc.* **37** (2006) 719-721.
[3] Y. Wang, S. Schlücker, *Analyst.* **138** (2013) 2224-2238.
[4] C. Jehn, B. Küstner, P. Adam, A. Marx, P. Ströbel, C. Schmuck, S. Schlücker, *PCCP* **11** (2009) 7499-7504.
[5] B. Küstner, M. Gellner, M. Schütz, F. Schöppler, A. Marx, P. Ströbel, P. Adam, C. Schmuck, S. Schlücker, *Angew. Chem. Int. Ed.* **48** (2009) 1950-1953.
[6] M. Schütz, B. Küstner, M. Bauer, C. Schmuck, S. Schlücker, *Small* **6** (2010) 733-737.
[7] M. Salehi, D. Steinigeweg, P. Ströbel, A. Marx, J. Packeisen, S. Schlücker, *J. Biophoton.* (2013), DOI: 10.1002/jbio.201200148

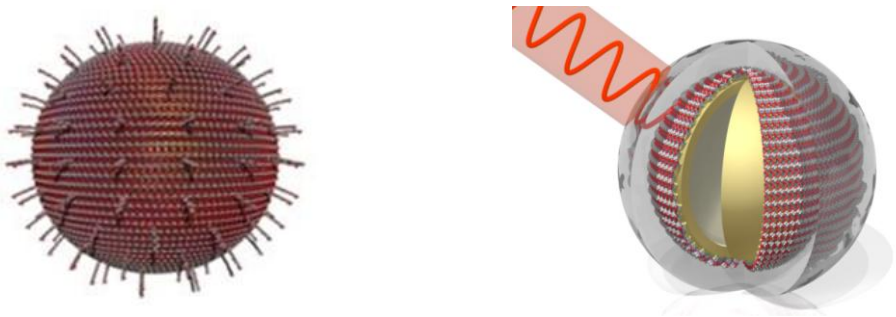

FIGURE 1. (Left) SERS labels [3] stabilized by many short and few longer hydrophilic spacer molecules for controlled bioconjugation [4]. (Right) SERS nanoprobes optimized for red laser excitation for minimizing tissue autofluorescence. Gold/silver nanoshells are covered by a complete self-assembled monolayer (SAM) of Raman labels. The SERS particle is protected and stabilized by a glass shell [5-6].