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# Core type as a factor of gap-enhanced Raman tags SERS response

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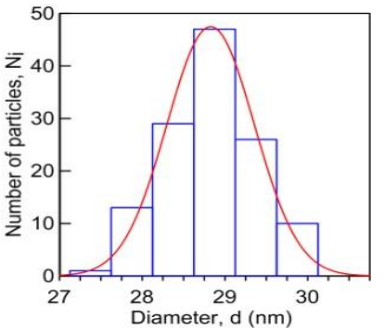
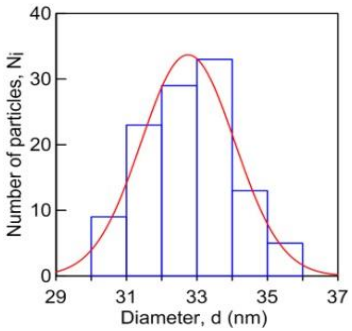
Among the many active SERS nanosystems, gap-enhanced Raman tags occupy a special niche. GERTs demonstrate high performance of the SERS enhanced factor, and therefore can be easily used in high-speed modes of bioimaging. In general, their structure is based on a noble metal nanocore surface coated with molecules of the Raman reporter and forming a gap between the core and the outer secondary shell. Total fundamental SERS enhancement factor of GERTs particles depends on a number of factors, including single or multilayer (nanomatryoshka) type of nanostructures, the type of nanocore, thickness of the gap, the type and structure of the outer layer and variety of Raman molecules used as reporters. In this regard, we synthesized GERTs based on nanospheres (AuNS), polygonal nanoparticles (AuNP), and gold nanorods, and studied the effect of the core shape on the SERS response.

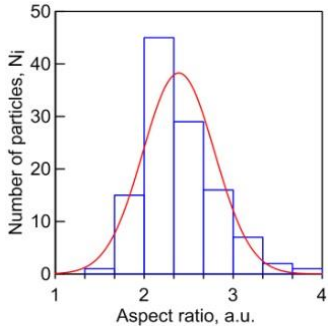
AuNS,
$d_{av}$=28,9±0,4 nm

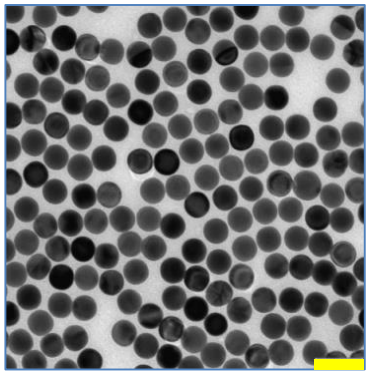
AuNP,
$d_{av}$=32,7±1,3 nm

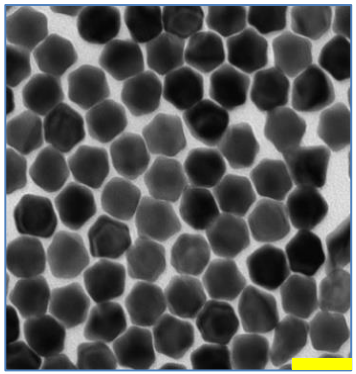
AuNR,
$l_{av}$=51±7 nm
$d_{av}$=21±3 nm

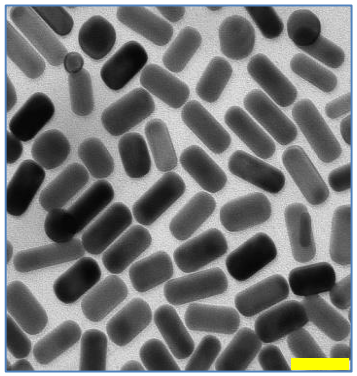


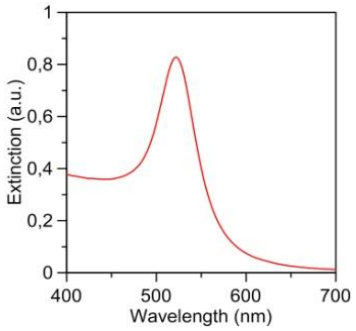



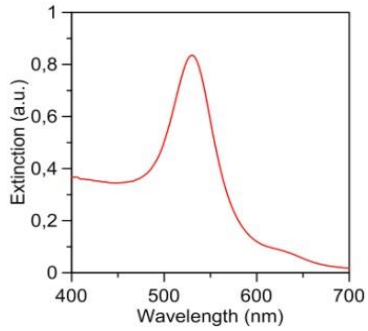



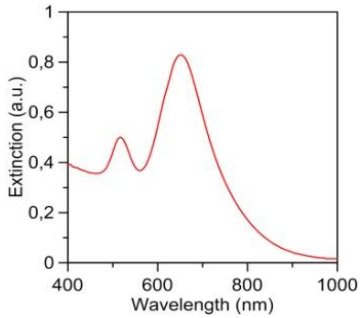





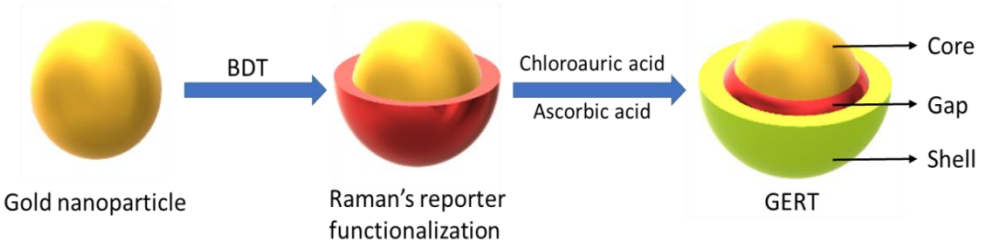




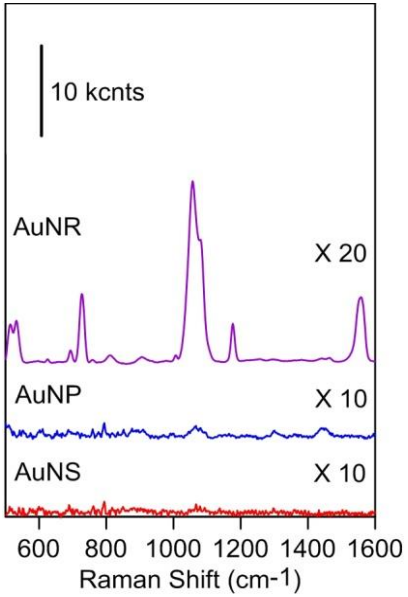



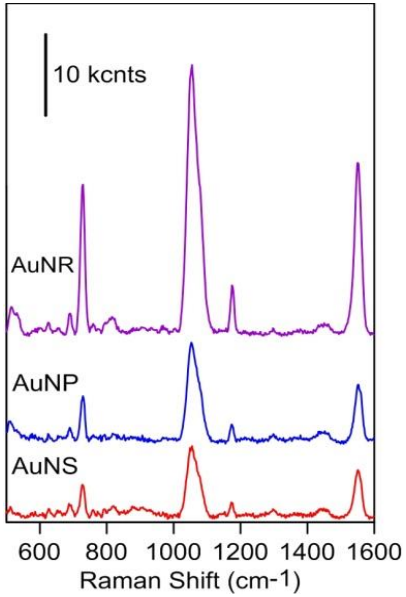



All synthesized types of nanoparticles were functionalized with Raman reporter molecules BDT;
GERTs were synthesized by reduction of hydrogen tetrachloroaurate (III) in the presence of ascorbic acid on the surface of nano-nuclei.




The SERS spectra were recorded under conditions equivalent for all particles: laser power 30 mW, signal accumulation time 30 sec, quartz cell 1 cm thick



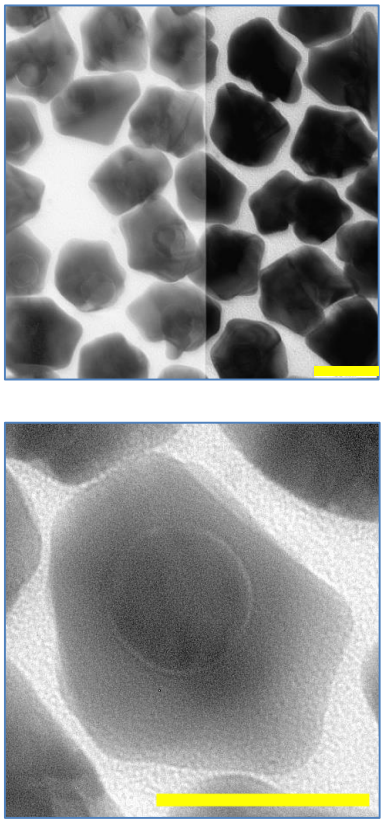
The fundamental SERS enhancement factors (EF) were calculated for all samples

| Sample | Molar concentration, M | Signal intensity, a.u. | Enhancment factor, SERS |
|---|---|---|---|
| BDT | 0,1 | 190 | - |
| AuNS@BDT | $1,6 \times 10^{-5}$ | 90 | $2,9 \times 10^{3}$ |
| AuNP@BDT | $9 \times 10^{-6}$ | 160 | $7,6 \times 10^{3}$ |
| AuNR@BDT | $8,6 \times 10^{-6}$ | 1020 | $6,2 \times 10^{4}$ |
| AuNS@BDT@Au | $2 \times 10^{-6}$ | 380 | $1 \times 10^{5}$ |
| AuNP@BDT@Au | $1,1 \times 10^{-6}$ | 510 | $2,4 \times 10^{5}$ |
| AuNR@BDT@Au | $1,1 \times 10^{-6}$ | 4110 | $2 \times 10^{6}$ |

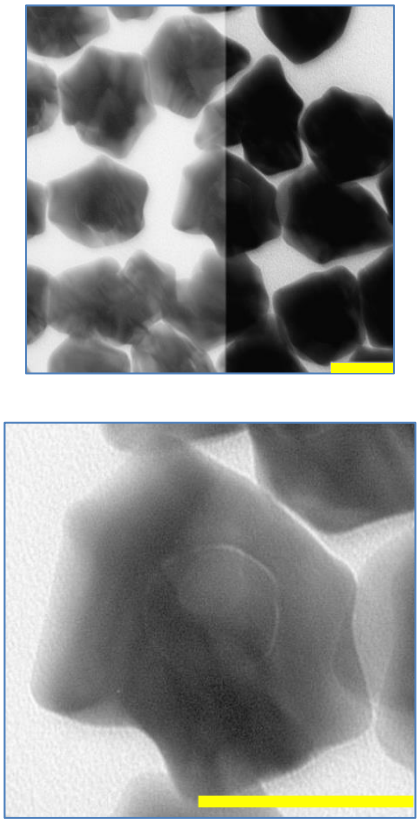
Enhancement of the SERS signal, as well as the EF value, increased in the series AuNS @ BDT <AuNP @ BDT <AuNR @ BDT and was maximal in nanorods with a functionalized reporter

TEM images of the resulting s-GERTS, bar 50nm

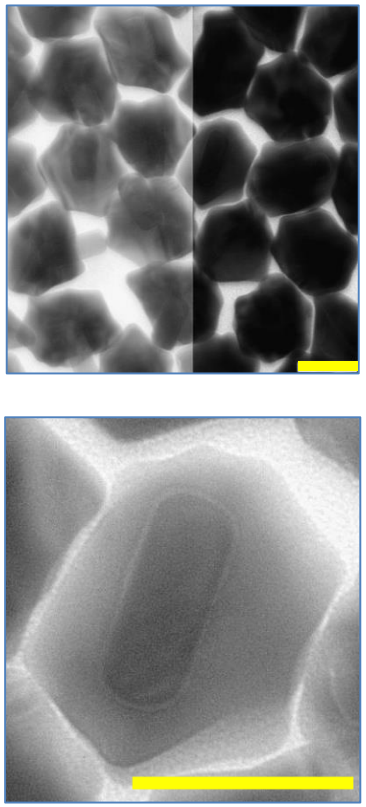
AuNS@BDT@Au



AuNP@BDT@Au



AuNR@BDT@Au



Shape of the nanocore significantly affects the signal intensity and the SERS enhancement factor for uncoated and GERTs nanoparticles, and maximum increase in the SERS signal and the enhancement factor was observed for nanorods.