Gluing negatively charged Au nanoparticles to negatively charged TMV rods.

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Abstract

Tobacco mosaic virus (TMV) is a rod shaped plant virus containing RNA and 2100 identical coat proteins. It has a length of 300 nm and a diameter 18nm. [1, 2]. TMV is a fantastic biotemplate for nanofabrication with its remarkable stability at high temperatures as well as in a pH range of 2.0 - 9.0. TMV protein tube harbours a number of functional groups e.g. amines, hydroxyls and carboxylates [2, 3].

We report here the high yield binding of citrate coated (6 nm) Au nanoparticles to the wild type (natural) TMV external protein residues by a simple method at ambient conditions. TMV particles are incubated with citrate coated Au nanoparticles in a solution of aqueous citric acid. The synthesis results in decoration of TMV along its whole length by Au nanoparticles. TMV had been already reported for Au decoration by other groups [4, 5, 6] but they either used a rather complicated synthesis or TMV Cystein mutants. We decorate negatively charged TMV rods with negatively charged Au nanoparticles exploiting the protonation of the acidic amino acid residues [7]. The complex nature of TMV allows to obtain a positively charged exterior, while the whole virus is negatively charged. Ligand exchange of Au nanoparticles [8] from citrate to 2-mercaptoethanol rendered the Au nanoparticles unable to bind to TMV protein rods. This approach of decorating TMV with citrate coated nanoparticles is not limited to Au nanoparticles, the same strategy produces (magnetite) Fe_3O_4-decorated TMV rods when citrate coated Fe_3O_4 particles were used instead of Au nanoparticles.

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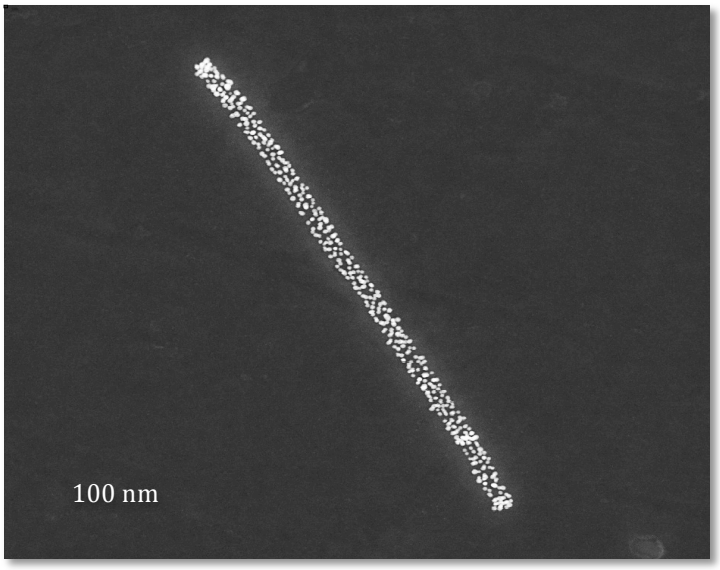

Figure 1. STEM image of two TMV rods decorated by citrate-coated Au nanoparticles.

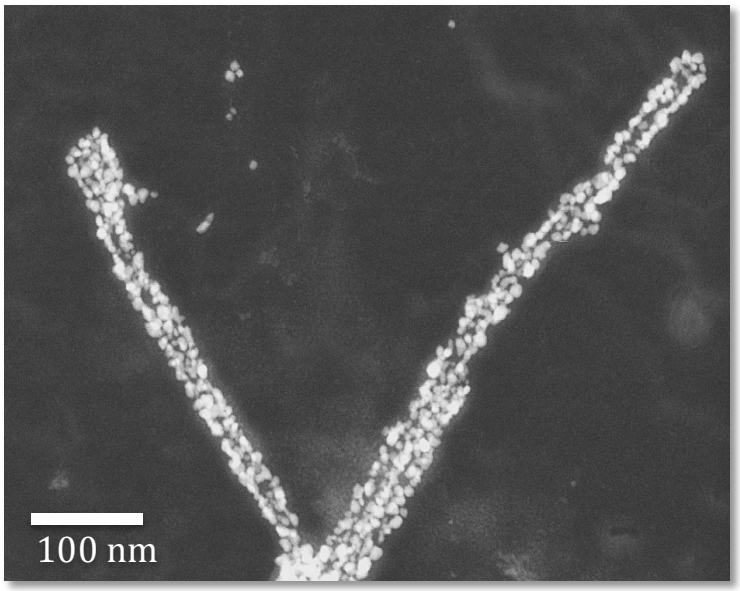

Figure 2. STEM image of TMV rods decorated by citrate-coated iron oxide nanoparticles.