

## Understanding the Kinetics of Protein–Nanoparticle Corona Formation

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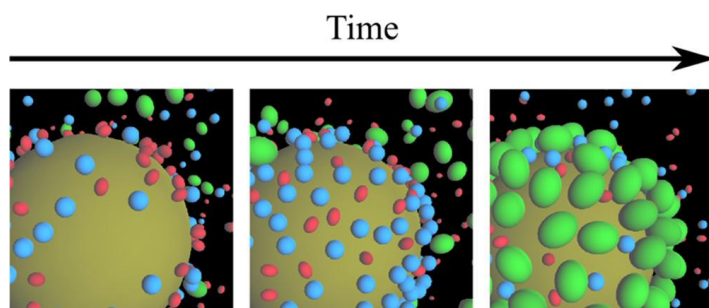
### Abstract

When a pristine nanoparticle (NP) encounters a biological fluid, biomolecules spontaneously form adsorption layers around the NP, called “protein corona”. The corona composition depends on the time-dependent environmental conditions and determines the NP’s fate within living organisms. Understanding how the corona evolves is fundamental in nanotoxicology as well as medical applications. However, the process of corona formation is challenging due to the large number of molecules involved and to the large span of relevant time scales ranging from 100  $\mu$ s, hard to probe in experiments, to hours, out of reach of all-atoms simulations. Here we combine experiments, simulations, and theory to study (i) the corona kinetics (over 10–3–103 s) and (ii) its final composition for silica NPs in a model plasma made of three blood proteins (human serum albumin, transferrin, and fibrinogen). When computer simulations [1] are calibrated by experimental protein–NP binding affinities measured in single-protein solutions, the theoretical model correctly reproduces competitive protein replacement as proven by independent experiments. When we change the order of administration of the three proteins, we observe a memory effect in the final corona composition that we can explain within our model. Our combined experimental and computational approach is a step toward the development of systematic prediction and control of protein–NP corona composition based on a hierarchy of equilibrium protein binding constants [2].

### References

- [1] P. Vilaseca, K. A. Dawson, G. Franzese, *Soft Matter*, 9, (2013) 6978–6985.
- [2] O. Vilanova, J. J. Mittag, P. M. Kelly, S. Milani, K. A. Dawson, J. O. Rädler, G. Franzese, *ACS Nano*, DOI: 10.1021/acsnano.6b04858 (2016)

### Figures



Kinetics of protein adsorption onto NPs.  
Red: Albumin, blue: Transferrin, green: Fibrinogen.

Figure 1