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Magnetic Viruses: Utilizing Self-Assembly for Biomedical Applications[1]

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Magnetic nanoparticles coated with biochemical surfactants have emerged recently as an important component for enabling many biological and medical applications. We implemented a biotemplating approach to create such magnetic nanoparticles by utilizing native protein capsid shells derived in high yield from the T7 bacteriophage virus.[3] The magnetic nanoparticles are grown via bio-mineralization reactions inside of hollowed-out capsids that retain their original chemical recognition properties. The resultant "magnetic viruses" are uniform in geometry, physical properties, and biochemical functionality. This makes these viruses ideally suited for many biomedical applications among which we investigated specifically a novel sensing scheme for target recognition based on Brownian relaxation.[4] For this scheme we use the *ac*-susceptibility of the functionalized magnetic nanoparticles suspended in liquid. Upon binding the target of interest to the particles, their Brownian relaxation time is modified, which is readily detected by a change of the frequency dependence of the magnetic susceptibility. This scheme has several advantages; (i) it requires only one binding event for sensing; (ii) there is a useful signal both in the absence and presence of the target; (iii) the signal contains information about the size of the target besides the biochemical affinity; and (iv) since the binding modifies the magnetic susceptibility of the magnetic particles there is no need for removing unbound labels.

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[2]With S.-H. Chung, K. Guslienko, S. D. Bader, C. Liu, Q. Jin, A. Sutton, F. Yan, B. K. Kay, L. Makowski, and L. Chen.
[3]C. Liu, S.-H. Chung, Q. Jin, A. Sutton, F. Yan, B. K. Kay, S. D. Bader, L. Makowski, and L. Chen, J. Magn. Magn. Mater, in press.
[4]S.H. Chung, A. Hoffmann, S. D. Bader, C. Liu, B. Kay, L. Makowski, and L. Chen, Appl. Phys. Lett. **85**, 2971 (2004); S. H. Chung, A. Hoffmann, K. Guslienko, S. D. Bader, C. Liu, B. Kay, L. Makowski, and L. Chen, J. Appl. Phys. **97**, 10R101 (2005).