ENCAPSULATION OF NANOPARTICLES IN COMPOSITE GEL MICROPARTICLES FOR LUNG IMAGING AND DRUG DELIVERY

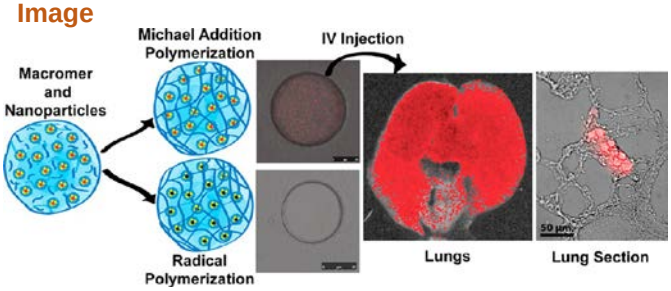
Nathalie M. Pinkerton,† Stacey W. Zhang,† Richard L. Youngblood,† Dayuan Gao,‡ Shike Li,‡ Bryan R. Benson,† John Anthony,§ Howard A. Stone,‖ Patrick J. Sinko,‡ and Robert K. Prud'homme*,†

†Department of Chemical and Biological Engineering, Princeton University, Princeton, New Jersey 08544, United States
‡Department of Pharmaceutics, Rutgers, The State University of New Jersey, Piscataway, New Jersey 08854, United States
§Department of Chemistry, University of Kentucky, Lexington, Kentucky 40506, United States
‖Department of Mechanical and Aerospace Engineering, Princeton University, Princeton, New Jersey 08544, United States

Abstract

The intravenous delivery of composite gel microparticles (cGMPs) offers a platform for localized treatment of lung cancer. We describe a method for fabrication of cGMPs with average diameters of 35 to 100 μm using shear emulsification and microfluidic droplet generation. We characterized the particles and describe the performance of these particles *in vivo*. Biodistribution of the cGMPs was selective to the lung after intravenous injection and particle clearance from the lung occurred in 7 weeks. One-week biodistribution studies demonstrated that larger, uniform particles produced by microfluidics provided optimal targeting to lung tissue. We demonstrated that highly loaded cGMPs containing a long wavelength fluorophore allow *in vivo* analysis of particle biodistribution without the need for *ex-vivo* organ analysis. The release of camptothecin conjugates from the nanopartricles, and thus, gel microparticles, is tuned from minutes to days by altering the polarity of the nanoparticle core.

Image



Recent Publications (minimum 5)

1. Pinkerton, N.M., et al., *Gelation Chemistries for the Encapsulation of Nanoparticles in Composite Gel Microparticles for Lung Imaging and Drug Delivery.* Biomacromolecules, 2014. **15**(1): p. 252-261.
2. D'Addio, S.M., et al., *Determining drug release rates of hydrophobic compounds from nanocarriers.* Phil. Trans. R. Soc. A, 2016. **374**(2072): p. 20150128.
3. D'Addio, S.M., et al., *Optimization of cell receptor-specific targeting through multivalent surface decoration of polymeric nanocarriers.* Journal of Controlled Release, 2013. **168**(1): p. 41-49.
4. D'Addio, S.M., et al., *Aerosol Delivery of Nanoparticles in Uniform Mannitol Carriers Formulated by Ultrasonic Spray Freeze Drying.* Pharmaceutical Research, 2013. **30**(11): p. 2891-2901.
5. D'addio, S.M. and R.K. Prud'homme, *Controlling drug nanoparticle formation by rapid precipitation.* Advanced drug delivery reviews, 2011. **63**(6): p. 417-426.
6. D'Addio, S.M., et al., *Antitubercular Nanocarrier Combination Therapy: Formulation Strategies and in Vitro Efficacy for Rifampicin and 5Q641.* Molecular Pharmaceutics, 2015. **12**(5): p. 1554-1563.
7. D'Addio, S.M., et al., *Antitubercular Nanocarrier Combination Therapy: Formulation Strategies and In Vitro Efficacy for Rifampicin and SQ641.* Molecular pharmaceutics, 2015.
8. Pagels, R.F., et al., *Controlling and Predicting Nanoparticle Formation by Block Copolymer Directed Rapid Precipitations.* Nano Letters, 2018. **18**(2): p. 1139-1144.
9. Pagels, R.F. and R.K. Prud'homme, *Polymeric nanoparticles and microparticles for the delivery of peptides, biologics, and soluble therapeutics.* Journal of Controlled Release, 2015. **219**: p. 519-535.

Biography (150 word limit)

Robert Prud'homme is a professor in the Department of Chemical and Biological Engineering at Princeton University. He is the founding director of the Program in Engineering Biology. His research program focusses on polymer self-assembly applied to drug delivery. The development of Flash NanoPrecipitation (FNP) in his laboratory enabled the encapsulation of poorly soluble drug compounds and oligonucleotides for therapy directed towards cancer, TB, and injections. FNP is a scalable and continuous process that is enables integrated processing and spray drying for low cost oral and aerosol formulations. Under sponsorship by the Bill and Melinda Gates Foundation, the process is being adopted to formulate new compounds coming from TBA, MMV, and DNDi.

Robert K. Prud'homme
Tel: +1 609 2584577
Invited lecture
Category:Oral
Email:Prudhomm@princeton.edu

Notes/Comments: