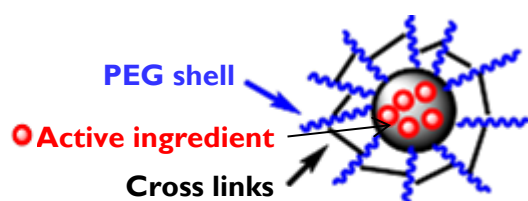


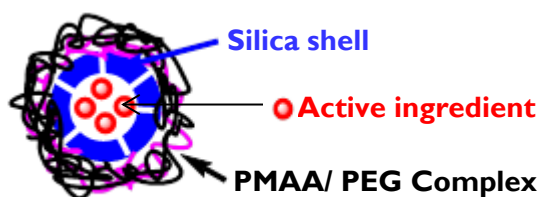
About the Capability

IMRE scientists have developed IMRE-proprietary smart capsules that can provide secure encapsulation of active ingredients, and release these active ingredients when the acidity level (pH) is changed.

Two categories of smart capsules were developed:



- Core-shell micelles with cross-linked poly(ethylene glycol) (PEG) shell



- Hollow silica spheres coated with poly(methacrylic acid) (PMAA) and PEG complex*

Key Features

- Provide secure encapsulation of active ingredients at pH below ca. 6.0
- Release active ingredients at pH higher than 6.0
- Use commercially available materials, which can be food grade, for preparation of capsules

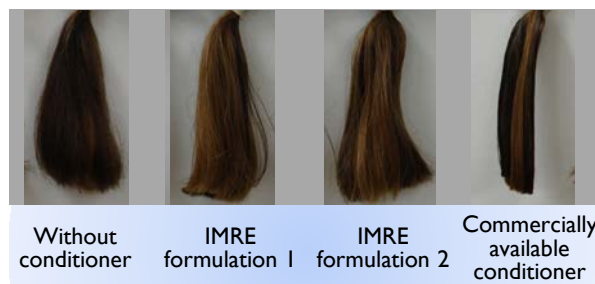
*Reference:

Ye Liu et al, A Rocket-Like Encapsulation and Delivery System with Two-Stage Booster Layers: pH-Responsive Poly(methacrylic acid)/Poly(ethylene glycol) Complex-Coated Hollow Silica Vesicles, *Macromolecular Rapid Communications*, 2013, 34, 1563-1568.

Performance Data

Capsules with different active ingredients:

- Capsules of Co-Q10**
 - Size: ca. 20 nm-100 nm
 - For oral administration, maximum plasma CoQ10 level (C_{max}): 4.75 $\mu\text{g/mL}$, higher than the amount required for health benefits.
- Capsules of Resveratrol**
 - Size: 10 nm to 1000 nm
 - Improved stability: Relative amount of resveratrol is 73% (0 °C), 71% (25 °C) and 69% (40 °C) after aging for 4 weeks
- Capsules of Silicon oil**
 - resulted in better hair appearance



Potential Applications

- Formulation of oil-soluble active ingredients, such as:
 - Co-Q10 with good bioavailability
 - Resveratrol with improved storage stability
 - Silicon oil with less weighing down of hair
- Formulation of water-soluble active ingredients, such as Vit C, with improved stability

Collaboration Opportunities

Work with industry to develop new formulations of various active ingredients with improved efficacy.



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