

## Next Generation Sunscreens

### About the Capability

The use of natural and nature-derived compounds in skin care applications has been receiving increasing attention due to their good UV-radiation protection and antioxidative and non-cytotoxic properties.

IMRE scientists have harnessed such properties from natural and nature-derived compounds like lignin, nanodiamonds and fullerenes for skin care products such as sunscreens.



Prototypes of nanodiamonds (ND), fullerene ( $C_{60}$ ) and lignin sunscreen. The colour intensity can be fine-tuned using different concentrations of ND,  $C_{60}$  and lignin.

### Potential Applications

- Multi-functional skin care products, e.g. sunscreen with anti-oxidative function
- Anti-aging skin care products in the form of skin-care serum, cream and lotion.

\*References:

(1) Kai, D.; Chua, Y. K.; Jiang, L.; Owh, C.; Yin, S.; Ac, C.; Loh, X. J. Dual Functional Anti-Oxidant and SPF Enhancing Lignin-Based Copolymers as Additives for Personal and Healthcare Products. *RSC Adv.* 2016, 6, 86420–86427.

(2) Kai, D.; Ren, W.; Tian, L.; Chee, P. L.; Liu, Y.; Ramakrishna, S.; Loh, X. J. Engineering Poly(lactide)-Lignin Nanofibers with Antioxidant Activity for Biomedical Application. *ACS Sustain. Chem. Eng.* 2016, 4 (10), 5268–5276

Reference No. IMRE-CCT-0001

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### Key Features

- Safe – Suitable for skin applications, as lignin, nanodiamond and fullerene are non-cytotoxic\* as shown by cell studies.
- Stable UV absorbers
  - Nanodiamond, fullerene and lignin are stable under sunlight and will not photo-degrade unlike typical chemical sunscreens.
  - Lignin enables strong absorption capability in the UV-visible regions due to the numerous UV chromophoric groups.
  - Nanodiamond and fullerene also show broad-spectrum UV protection due to their excellent scattering and absorption properties.
- Stable anti-oxidants
  - Nanodiamond, fullerene and lignin are excellent antioxidants and do not photo-degrade like Vitamin C, a common anti-oxidative additive.
  - Titanium dioxide and zinc oxide are common physical UV-filters but there have been reports that they could generate harmful reactive oxygen species (ROS) under sunlight. ROS may cause photo-aging and skin cancer, and antioxidants such as nanodiamond, fullerene and lignin can help prevent this.

### Collaboration Opportunities

- Research and development with skin care companies for new generation sunscreen products, or with packaging companies to develop packaging with UV-blocking features.



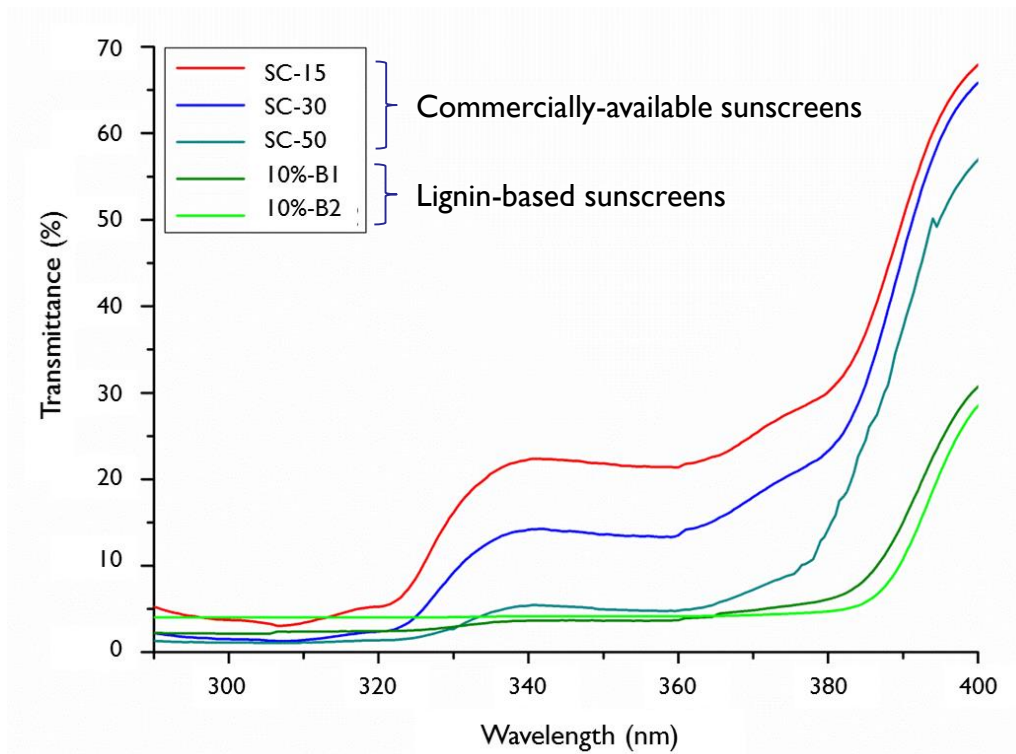
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## Performance Data



Better UV absorption by IMRE's lignin-based sunscreen compared with commercially available ones.