

Identifying the physical features of basic sensory descriptors: the ultrasonic microrheology as a starting point

Vincent Gauthier, Emmanuel Caplain, Stéphane Serfaty

Laboratoire SATIE – CY Cergy Paris Université, 5 Mail Gay Lussac, 95000 Neuville-sur-Oise

*Corresponding author e-mail: vincent.gauthier@cyu.fr

Foresee, or even design, the sensation produced by multiphase materials like creams, gels or emulsions, as early as they are designed, is at stake for cosmetic industry, as it is the first feature evaluated by the consumer. The resort to experts panel is a solution, which comes with its own issues regarding the setting and maintenance costs as but also the results bias. Relying on measurement devices is also possible with the statistical correlations between panels and instrumental results [1]. In this case, the prediction implies the resort to new measurement devices which are effective enough to be able to characterize multi-physical and multi-scale interactions (between product components and with product environment) [2]. It also entails the identification of typical physical quantities linking the instrumental study with data extracted from sensory analysis based on expert panel.

In the poster proposed here, the idea is to identify some physical features of basic sensory descriptors without resorting to statistical tools. Indeed, the latter are biased when the number of samples regarding the sensory descriptors one is small, and they restrain the description of these complex descriptors with linear mathematical laws. The proposal is to combine some microrheological quantities (complex shear modulus, apparent viscosity, structural coefficient), obtained with a non-destructive ultrasonic sensor based on a thickness shear-mode quartz [3]. The combination is done with simple mathematical operations (additions and multiplications) following the philosophy of Boolean approach. This can relate to the basic behavior of a single artificial neuron.

Firstly, the potential of ultrasonic microrheology for the physical description of sensory behaviour is highlighted by sorting cosmetic products differing from their texturing agent with principal component analysis. Then, the identification of the *spreading easiness* and *penetration ability* is done with products used in the training of experts panel (EBITouch[®] kit). The validation is performed with academic products [1]. If the *spreading easiness* seems to be well described by the product of the complex shear modulus real and imaginary parts, this is not really validated. This can be explained by the need of considering the skin-product interactions and opens fine prospects for the future.

- [1] L. Gilbert, C. Picard, G. Savary, and M. Grisel, "Rheological and textural characterization of cosmetic emulsions containing natural and synthetic polymers: relationships between both data," *Colloids Surfaces A Physicochem. Eng. Asp.*, vol. 421, pp. 150–163, Mar. 2013, doi: 10.1016/j.colsurfa.2013.01.003.
- [2] V. Gauthier, D. Desplan, S. Serfaty, M. Michiel, E. Caplain, and J.-Y. Le Huerou, "Multi-Frequency Ultrasonic Shear Waves Rheology for Soft Materials Monitoring in Cosmetics," in *2017 Cosmetic Measurements And Testing (COSMETIC)*, Jun. 2017, pp. 1–4, doi: 10.1109/COMET.2017.8521464.
- [3] V. Gauthier, E. Caplain, S. Serfaty, M. Michiel, P. Griesmar, and N. Wilkie-Chancellier, "Soft Matter Characterization From Ultrasonic Microrheology and Fractional Calculus," *IEEE Sens. J.*, vol. 22, no. 1, pp. 162–173, Jan. 2022, doi: 10.1109/JSEN.2021.3130037.