FOURIER TRANSFORM RHEOLOGY - A UNIVERSAL NONLINEAR MECHANICAL CHARACTERISATION OF DILUTE EMULSIONS

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Emulsions are a class of materials in which two or more constituents are blended together to create a new material able to tailor the properties of a "composite" material without resorting to expensive chemical synthesis. The typical microstructure of a dilute emulsion at rest consists of spherical droplets immersed in a continuous matrix. The size and size distribution of these globular domains strongly affect both the processing and the mechanical properties of final products.

The traditional approach to probe emulsions are often based on linear frequency shearing flow experiments, where the evaluation of the linear moduli G' and G" in small amplitude oscillatory shear (SAOS) experiences can be easily correlated to the blend morphology, by exploiting consolidated models (e.g. Palierne model [1]). These models give an estimation of the average droplet size in the case of globular morphology of the dispersed phase.

Recently [3.4], Fourier Transform Rheology (FTR) has been exploited to provide insights on the blend morphology. FTR is an oscillatory shear experiment with large amplitude oscillatory shear (LAOS). The response is no longer linear but consists of an overlay of the excitation frequency and its higher harmonics [5].

In this contribution FTR allowed the introduction and definition of E, a dimensionless universal curve for emulsions, that establishes a universal correlation among (i) the ratio of the higher harmonics $I_{5/3}$, (ii) the capillary number Ca and (iii) the viscosity ratio λ. Its limiting value as the strain deformation tends to zero is universal and holds for any dilute emulsion with Newtonian constituents. This universal value can be eventually exploited to infer blend properties as the average droplet radius or, alternatively, the interfacial tension between the two constituents.

Preliminary results on model blends confirm the validity of the approach.

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