

COLLEXISM-2024

“On micro-resonators used for dynamic monitoring of stability and phase transitions intrinsic to colloids and gels”

Collaborations :



CentraleSupélec



CentraleSupélec



rennes



RENNES



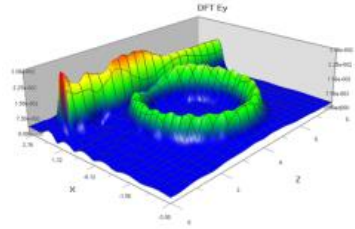
Nantes
Université



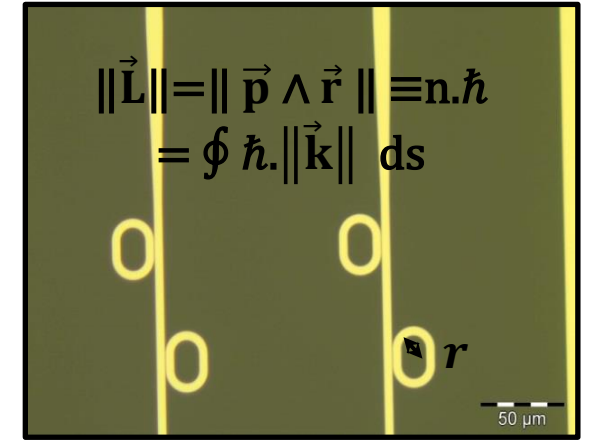
Université
de Rennes



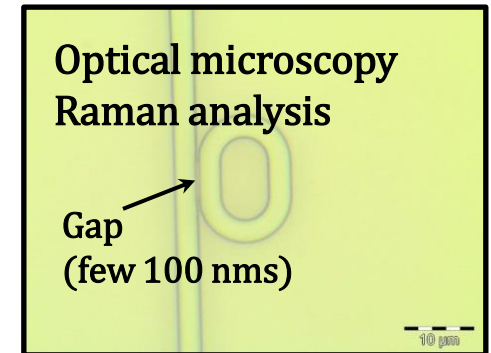
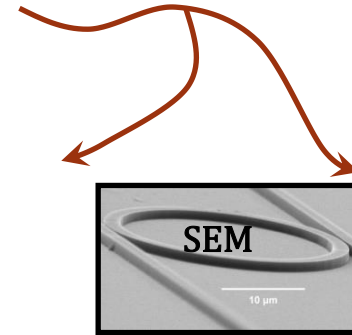
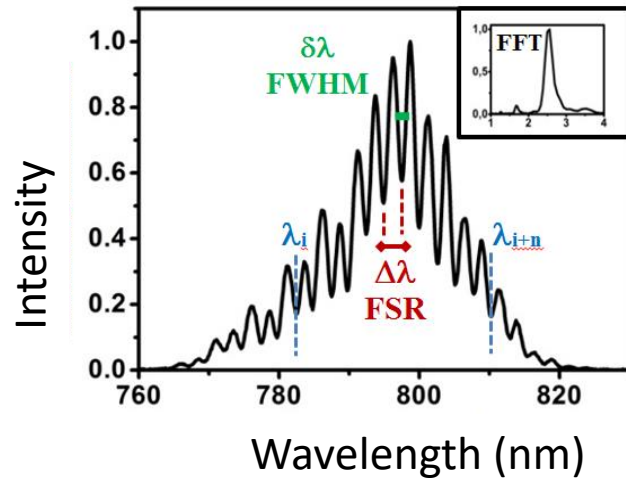
i) Theory Simulation



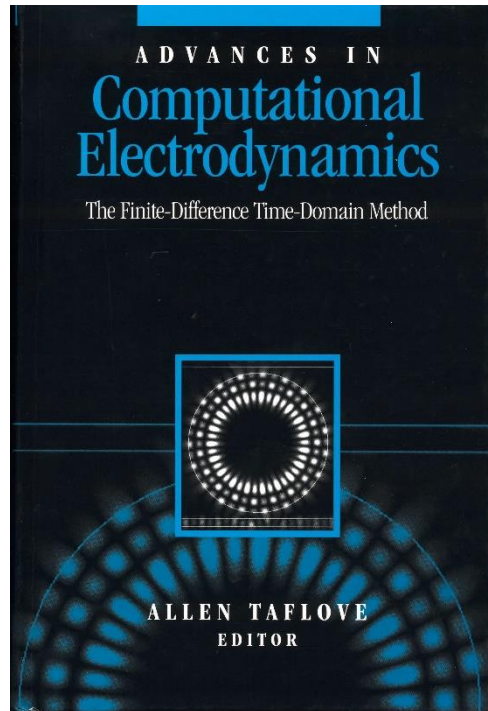
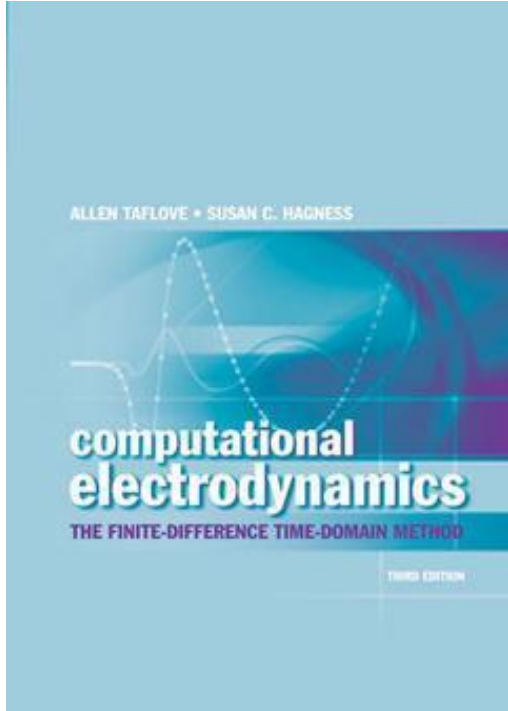
ii) Organic material Processes ('cheaper') - Quality Control



iii) Platform of characterisation/ Opto-Electronics, Opto-Mechanics



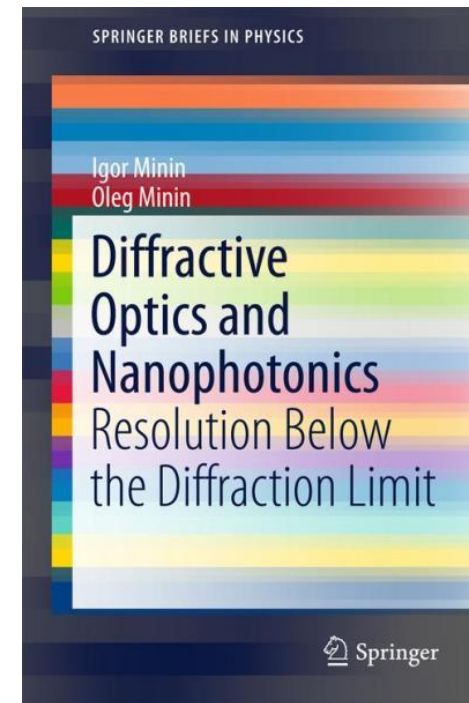
iv) Mathematic and Signal treatment / in live + in situ...



Allan TAFLOVE [1949-2021]

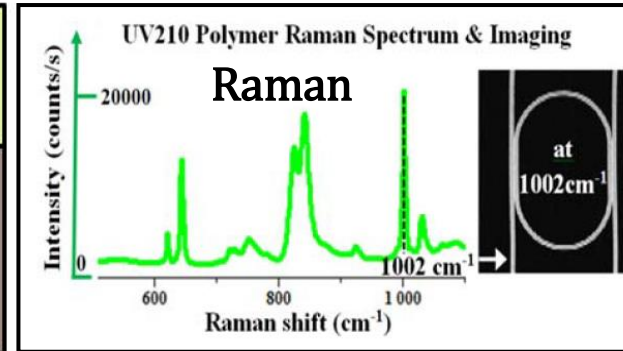
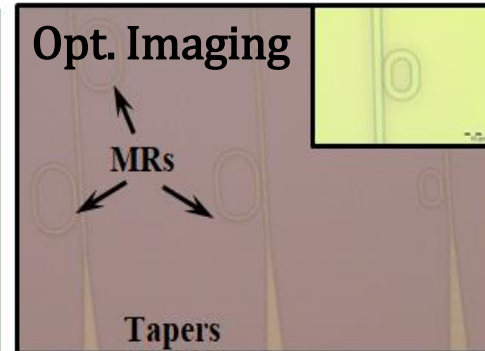
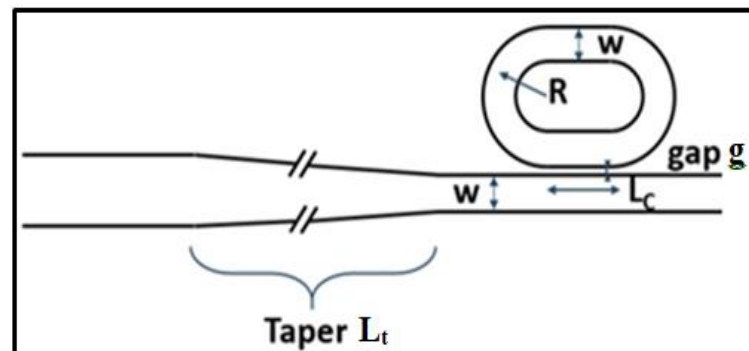
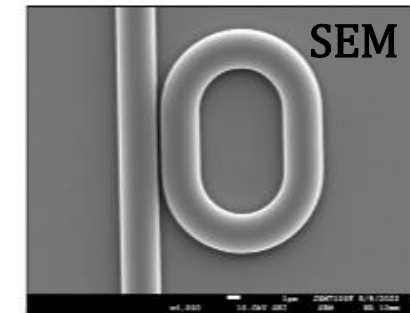
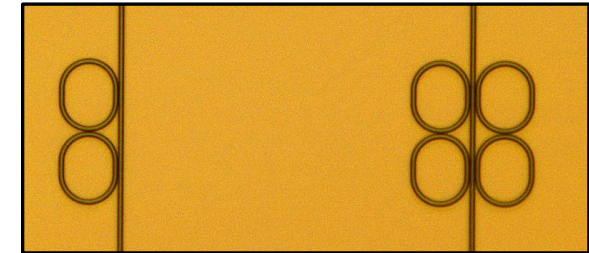


Igor and Oled Minin
with me at IPR in 2015



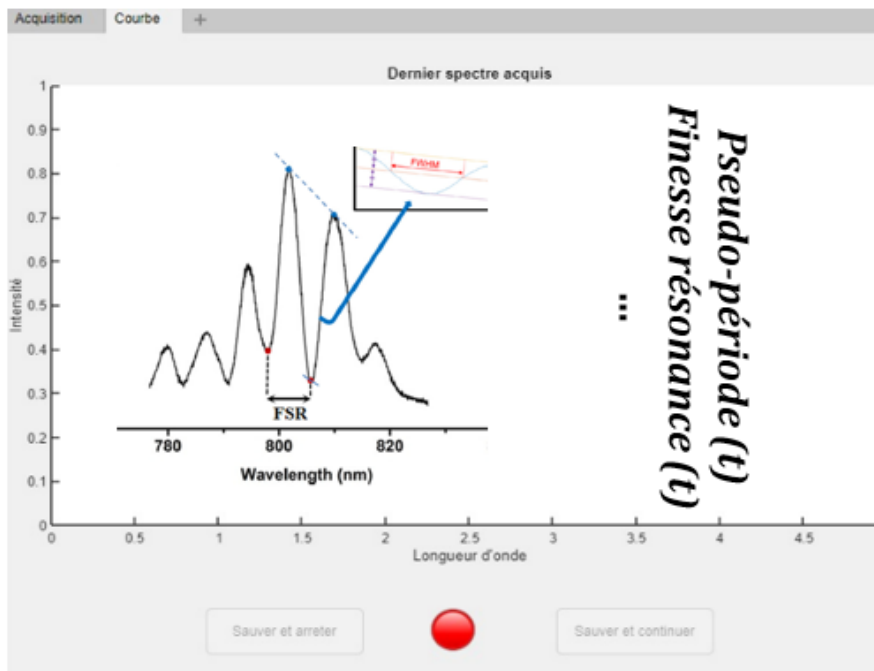
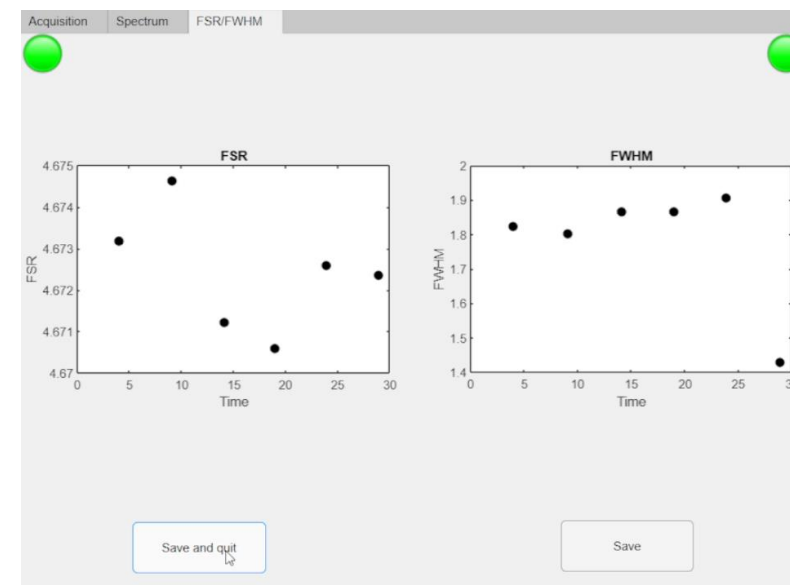
DUV 210 Photolithography + Quality control of circuits/various microscopies or imaging

Thermal oxidation (SiO ₂ into Si)	Parameters
<u>Humid pyrolytic oxidation</u> (AET Technologies)	4h35min at 1175°C - i) O ₂ (2 l/min) + N ₂ (2 l/min) 5 min - ii) O ₂ (2 l/min) 10 min - iii) H ₂ (1.8 l/min) + O ₂ (1 l/min) 4 h - iv) N ₂ (2 l/min) 20 min
Photolithography procedure /steps (Organic UV210)	Parameters
Spin-coating (v,a,t), thickness, roughness <u>Softbake</u> Deep UV exposure + Post-exposure soft-bake Development + Final <u>softbake</u>	(900 rpm, 5000rpm/s, 30s), ~800-850 nm, <3 nm 3 min at 140°C E = 20 mJ/cm ² during 27 s + 1 min at 120°C 30 s, with <u>Microposit MF CD-26</u> + 24 h at 120°C



+ AFM, XPS

- Real time obtained, adaptable to a whole range of spectrometers

Type de fenêtres traçant les paramètres spectraux de résonances quantifiées

Inter Deposit Digital Number
Certificat délivré par
Agence pour la Protection des Programmes
54 rue de Paradis - 75010 PARIS - FRANCE / SIREN 385 844 71 / +33(0)1 40 35 03 03 / app@app.asso.fr

IDDN.FR.001.420019.000.S.P.2019.000.30640

Pour l'œuvre : RAST "Resonance-Acquisition-Signal Treatment" version 1.0 en date du 31 juillet 2019

Identité des titulaires de droits* :
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Siren : 192509381

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3 rue Michel-Ange
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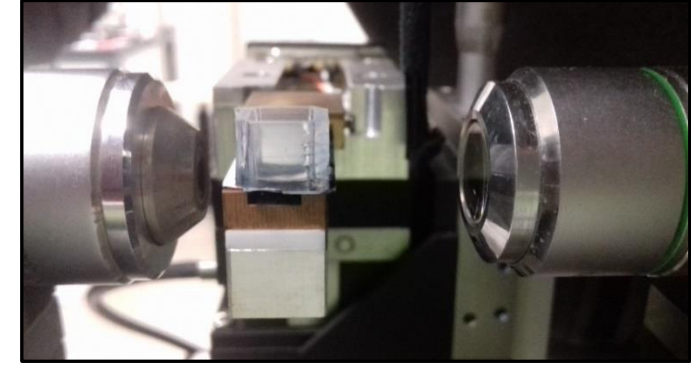
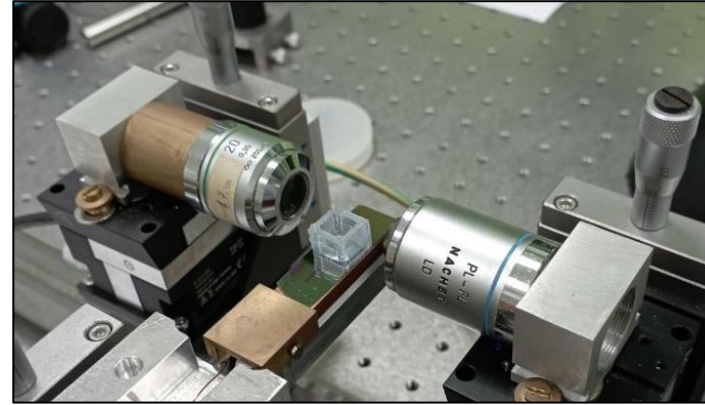
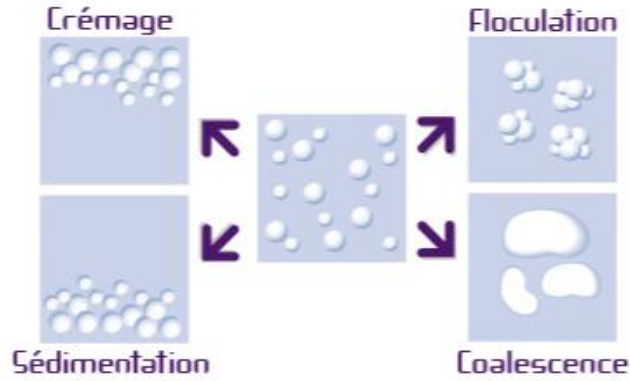
PATENT

Adhérent sous le numéro : 92.35.26 (1)
Support utilisé : 1 clé USB en double (2)

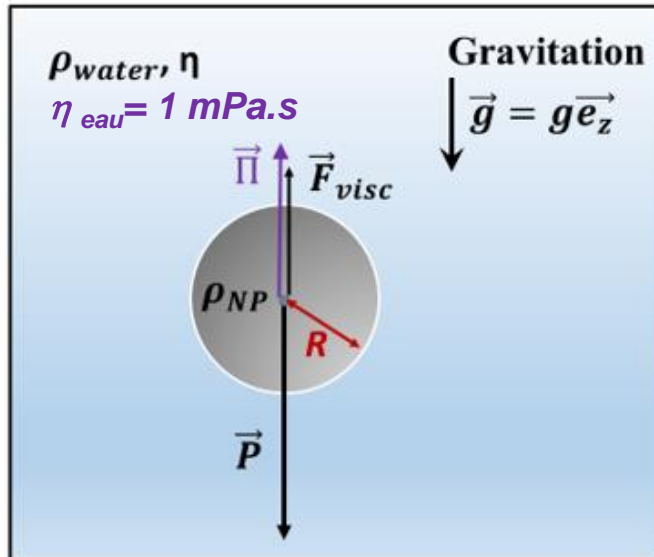
Logibox conservée par l'adhérent : 124240
Logibox conservée par l'APP : 124241

Fait à Paris, le 09/10/2019

(1) Base Proprité Digital Number (2) Numéro de l'œuvre (3) Numéro de l'organisation d'origine (4) Type de l'œuvre (5) Type de l'œuvre (6) Année de l'œuvre (7) Type de l'œuvre (8) Année de l'œuvre (9) Type de l'œuvre (10) Année de l'œuvre
* Le titulaire s'engage à informer l'APP de toute cession ou aliénation, totale ou partielle, de ses droits de propriété intellectuelle.
Seules les inscriptions de type S et C permettent un échantillonnage au programme source.



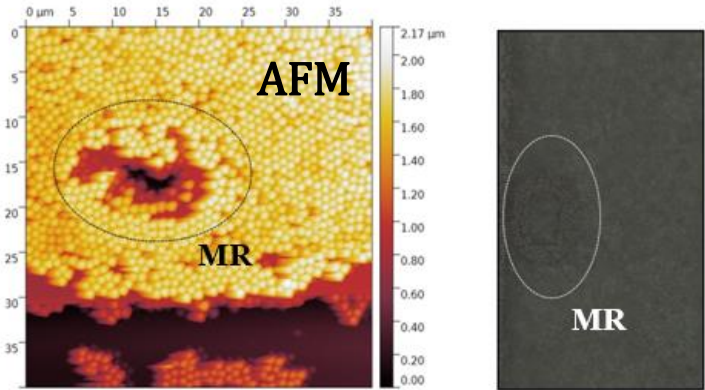
▪ Sedimentation process and measurements

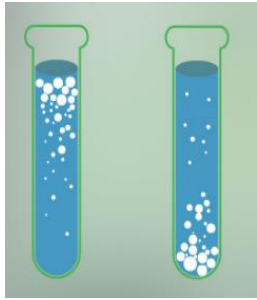


$$v_{\text{Stokes}}^{\text{séd}} = \text{cste.} \frac{D^2(\Delta\rho)}{\eta}$$

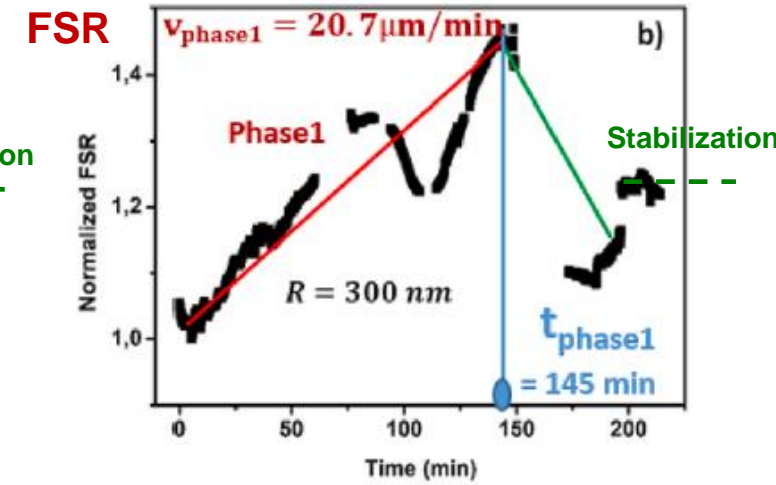
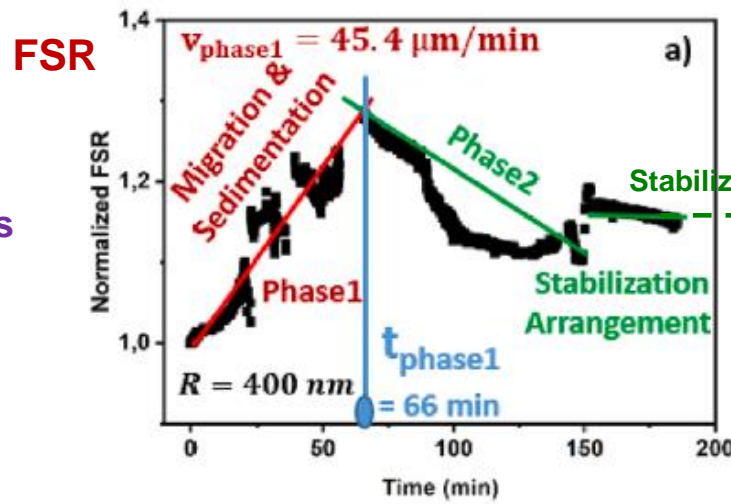
$$\Delta\rho \propto \Delta n_{\text{opt}} \text{ (Gladstone type law)} \propto -\frac{\Delta FSR}{(FSR)^2}$$

Fluid viscosity η





→ $V_{\text{sedimentation}}$ possible measurements for velocities of $[10-50] \mu\text{m}/\text{min}$



Average of various experiments at different h_{height} of water (2, 3 mm)

Dimensions of the Nano-Particles (nm)	R-radius	250	300	400
Sedimentation Velocity ($\mu\text{m}/\text{min}$)	$\bar{v}_{\text{sed,th}}$ Theoretical with Stokes formula	13.5	19.4	34.5
	$\bar{v}_{\text{sed,exp}} = h_{\text{water}} / t_{\text{contact}}$ Average of Experimental with various h_{water} (2 and 3 mm)	15.5	17.5	42.8
	Relative difference (%)	12.9	9.7	19.3

Fragmented matter (cloud) => gap [9-19] % compared to simple theoretical model of one spherical particle v_{Stokes}

cc: This device detects the sedimentation velocities of fragmented matter (cloud and colloid)

Patents: B. Bêche, H. Lhermite, V. Vié, L. Garnier, 'Méthode de détermination d'une vitesse de sédimentation', copropriété CNRS/Université Rennes 1, n° d'enregistrement FR 18 00110, (2018) + brevet international extension PCT n° PCT/EP2019/051103, 'Method for determining a sedimentation or creaming rate' (2019) + United States, Patent n° : U.S. Application Number n° 16/966,416. (2020).

On the detection of nanoparticle cloud migration by a resonant photonic surface signal towards sedimentation velocity measurements

L. Garnier^a, J. Gastebois^a, H. Lhermite^a, V. Vié^b, A. Saint-Jalmes^b, H. Cormerais^{a,c}, E. Gaviot^d, B. Bêche^{a,*}

PATENT



US 20200363307A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2020/0363307 A1
BECHE et al. (43) Pub. Date: Nov. 19, 2020

(54) METHOD FOR DETERMINING A SEDIMENTATION OR CREAMING RATE

(30) Foreign Application Priority Data

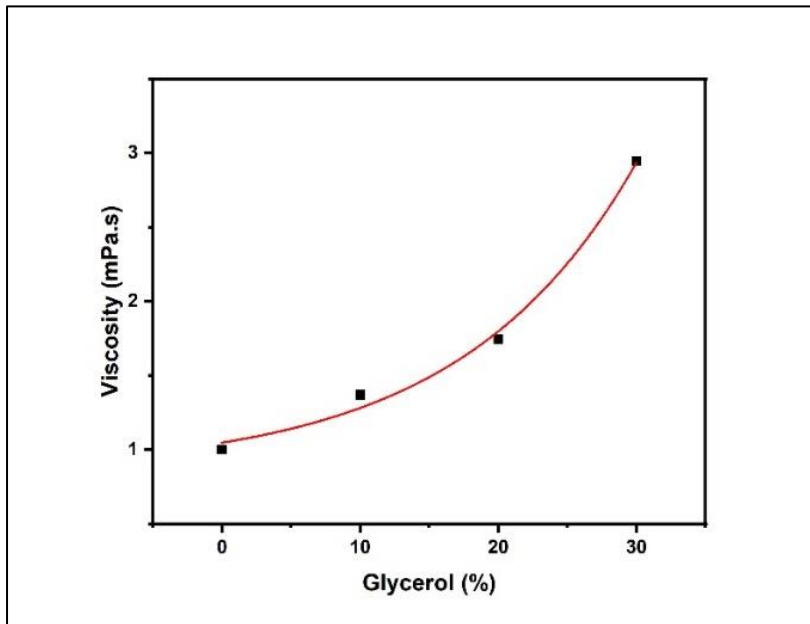
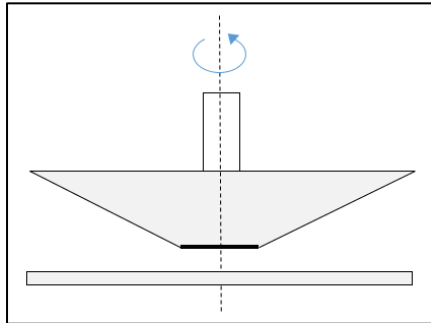
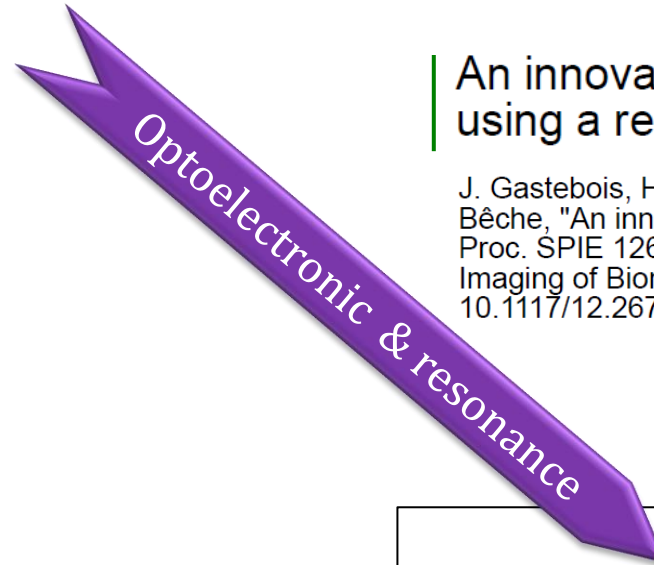
Feb. 2, 2018 (EP)

1800110

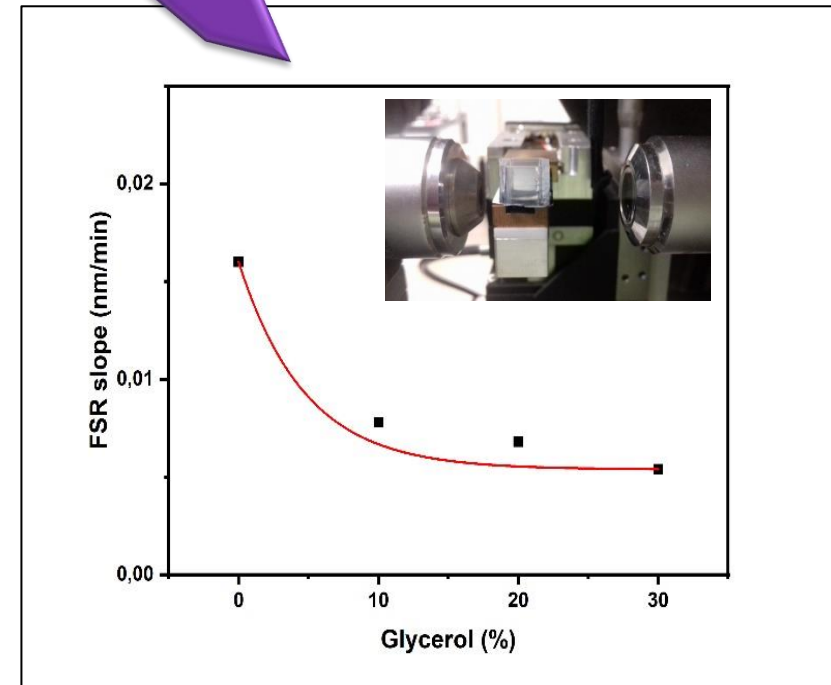
▪ Viscosimeter function operation and mode

An innovative optical viscometer using a resonant surface signal

J. Gastebois, H. Lhermite, H. Cormerais, A. St. Jalmes, V. Vié, L. Garnier, B. Bêche, "An innovative optical viscometer using a resonant surface signal," Proc. SPIE 12622, Optical Methods for Inspection, Characterization, and Imaging of Biomaterials VI, 126220N (11 August 2023); doi: 10.1117/12.2672418



Inverse mathematical operation



Sedimentation and viscosity in blood

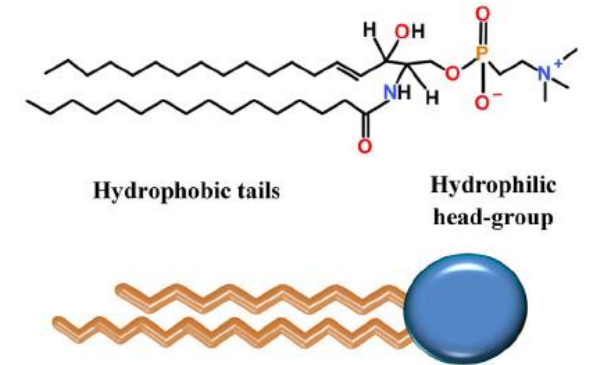
On the dynamic monitoring of the variations in blood viscosity by resonant optical signal

Lucas Garnier, Hervé Lhermite, Timothée Labouret, Arnaud Saint-Jalmes, Hervé Cormerais, Véronique Vié, Bruno Bêche, "On the dynamic monitoring of the variations in blood viscosity by resonant optical signal," Proc. SPIE 12139, Optical Sensing and Detection VII, 121390A (17 May 2022); doi: 10.1117/12.2617996

Phases transitions in biology and molecular physic

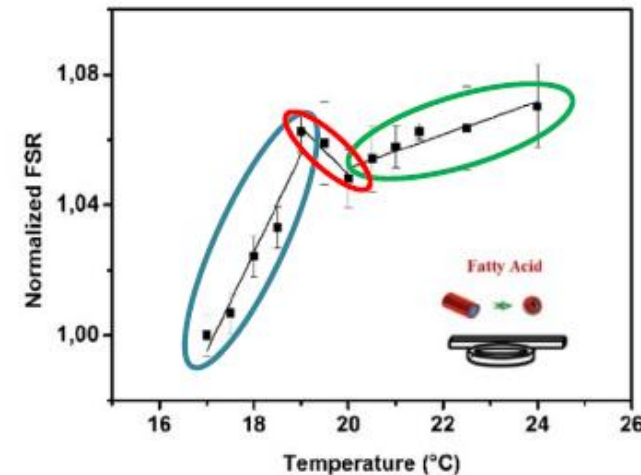
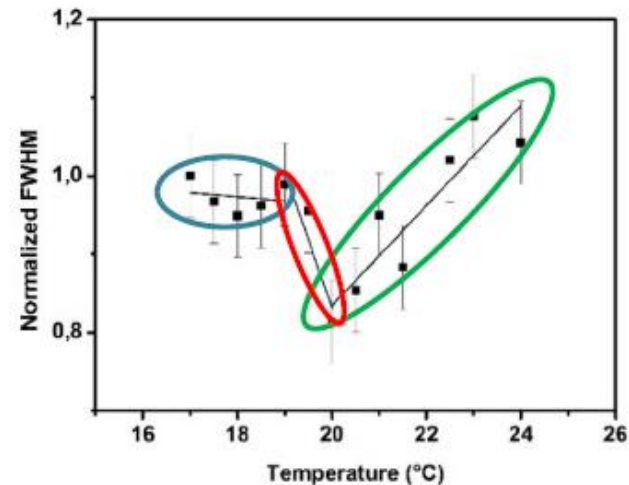
Polymer resonators sensors for detection of sphingolipid gel/fluid phase transition and melting temperature measurement

Qingyue Li^a, Véronique Vié^a, Hervé Lhermite^b, Etienne Gaviot^c, Claire Bourlieu^d, Alain Moréac^a, Denis Morineau^a, Didier Dupont^e, Sylvie Beauflis^a, Bruno Bêche^{a,*}



Microphotronics for monitoring the supramolecular thermoresponsive behavior of fatty acid surfactant solutions

R. Castro-Beltrán^a, L. Garnier^b, A. Saint-Jalmes^b, H. Lhermite^c, H. Cormerais^{c,d}, A.-L. Fameau^e, E. Gicquel^b, B. Bêche^{b,c,*}





The « Turbiscan » device of Formulation industry (or equivalent at LUM GmbH) that measure stability = approach by bulk (volume) and wave intensity aspect
 But problems with dark and/or opaque substances !



Approach by guided quasi-surface wave and resonance aspect allow such analyses in stability.

Some industries interesting with such new approach.

Thank you for
your attention

