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Viscoelastic material monitoring using an acoustical cylindrical spectrometer

Nicolas Wilkie-Chancellier, Loic Martinez, Pascal Griesmar and Stéphane Serfaty
ECIME Université de Cergy-Pontoise, rue d'Eragny, 95031 Neuville-sur-Oise, France

Acoustic sensors often have a plane geometry due to manufacturing constrains. In the present work, the cylindrical geometry is investigated with a normal incident beam in order to suppress the edge effects on mode conversion. The experimental setup uses an aluminium cylindrical shell. A classical immersion transducer (2 MHz central frequency) sends a plane pulse wave on the shell at normal incidence. A second immersion transducer can turn around, enabling the observation of the waves scattered by the cylindrical shell. Previous works have shown that the acoustic field scattered by the shell as a rainbow structure enabling the acoustic spectrometry of the material poured inside the shell. From these results, the present study proposes an acoustical model linking the resonances parameters to the material ones, enabling the monitoring of time varying viscous materials. Several gelation monitoring experiments are performed and analysed using the proposed model. Results are in good agreement with quartz sensor measurements and offer a good alternative to wide frequency range measurements.