The Dynamic Mobility

Abstract

Shows how the Dynamic Mobility is a key factor in determining the size of particles and also the particle charge (through the zeta potential, ζ).

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1 Introduction

The electroacoustic signal allows us to determine the dynamic mobility of the particles in a colloidal suspension. According to the theory developed by Dr Richard O'Brien, the ESA signal is related to the dynamic mobility, μ_d by the following formula:

$$ESA = A(w) f \frac{\Delta r}{r} Zm_d$$

where $A(\omega)$ is a calibration function, ϕ is the volume fraction of particles, and $\Delta\rho$ is the difference in density between the particles and the suspension medium which has density ρ. Z is determined by the acoustic impedance of the suspension and is automatically measured by the instrument.

Both the ESA signal and the dynamic mobility are complex quantities. That means that each must be specified by a pair of numbers. One member of the pair is called the magnitude and the other is called the argument (or phase angle).

The above equation holds at essentially any particle concentration so we are able to determine the dynamic mobility without approximation up to concentrations as high as 60 % by volume (or even higher).

2 Dynamic Mobility

The dynamic mobility is related to the size of the particles and also to the particle charge (through the zeta potential, ζ). For particle concentrations up to about 5% by volume that relation can be written (O'Brien 1988, 1990):

$$m_d = \frac{2ez}{3h} G(a,w)[1+ f]$$

where ε is the dielectric permittivity and η is the viscosity of the suspension medium.

Both G and f are complex functions but their exact form need not concern us for the moment. G depends on the particle size and the measuring frequency ω.

This effect can easily be seen in the following graphs, showing the dynamic mobility function at different frequencies for particles of different radius. It is this effect which enables us to determine the particle size in the range from about 0.1 to 10 microns.

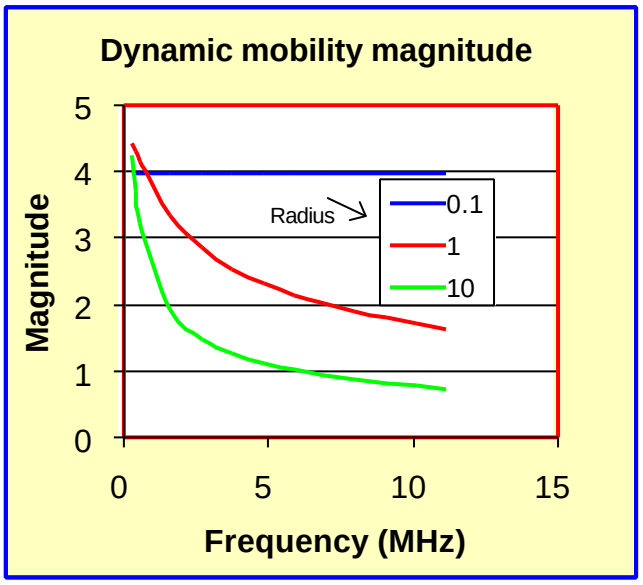

FIGURE 1: DYNAMIC MOBITILITY MAGNITUDE

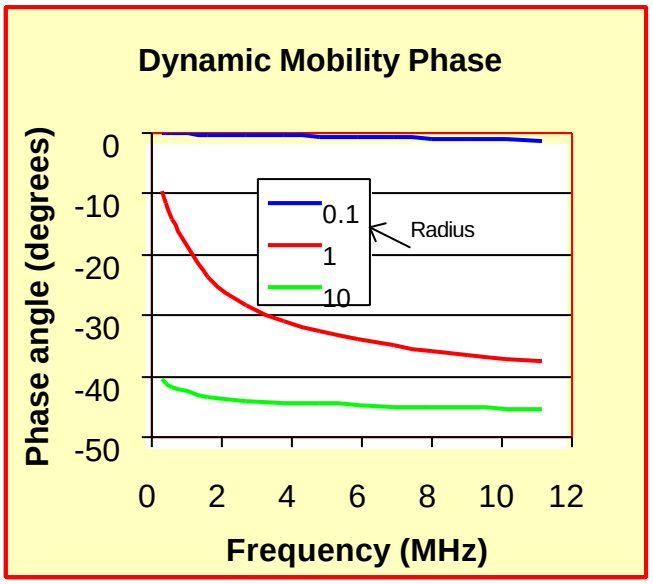

FIGURE 2: DYNAMIC MOBILITY PHASE