THIRD SOUND PROPERTIES (MKS UNITS)

The third sound speed at a film thickness h is essentially $\sqrt{gh}$ where the van der Vaals force (per unit mass) at the film surface is used for g. At absolute zero, there is also a modification due to an inactive portion of the film, a combination of a "solid layer" at the substrate and wavefunction healing lengths at both surfaces.

physical constants... Boltzmann and particle mass $k := 1.3805 \cdot 10^{-23}$ $m_4 := 6.646 \cdot 10^{-27}$

film parameters... $h_1 := 3.578 \cdot 10^{-10}$ 1 layer $\rho := \frac{m_4}{h_1^3}$ density

$T_v := 39$ $\beta := 41.7$ van der Waals strength and retardation

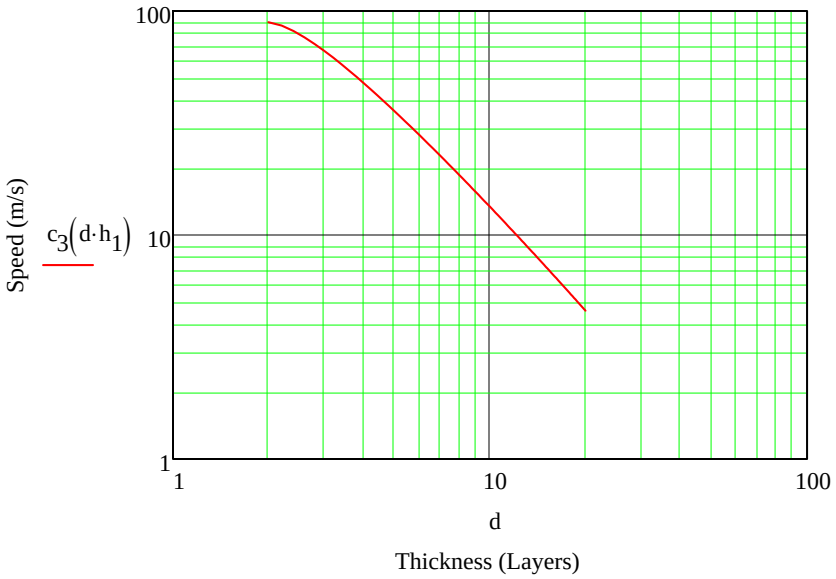
$D := 1.46 \cdot h_1$ inactive thickness

Putting all this together into $c_3^2 = \frac{\rho_s}{\rho} \cdot h \cdot \frac{d}{dh} U(h)$ gives...

T=0 third sound speed $$c_3(h) := \sqrt{\left(1 - \frac{D}{h}\right) \cdot \frac{3 \cdot k \cdot T_v}{m_4} \cdot \left(\frac{h_1}{h}\right)^3 \cdot \frac{\beta \cdot \left(\beta + \frac{4}{3} \cdot \frac{h}{h_1}\right)}{\left(\beta + \frac{h}{h_1}\right)^2}}$$

Here's a plot of speed (m/s) vs height (layers)

$d := 2, 2.2 .. 20$


100
10
1
Speed (m/s)
$c_3(d \cdot h_1)$
1
10
100
d
Thickness (Layers)