As a rule of thumb, a loudspeaker driver (cone type) should not exceed in physical size the wavelength it is required to produce.

a. Why not?

b. How big can a tweeter be, if it must produce 14KHz (about the upper limit of a middle-aged chemistry professors who always took good care of his ears or a 25-year-old who is into very loud music).

c. How big can a woofer be, if it crosses over to the tweeter at 1400 Hz?

2. What does the question above have to do with polymer science?

a) Because the speaker is larger than the wavelength producing, then the waves are more likely to arrive out of phase unless you are directly in front of the speaker.

b) \( v = f \lambda \)
   \( v = 343.6 \text{ m/s @ } 20^\circ C \) \( f = 14000 \text{ Hz} \)
   \( \lambda = \frac{343.6 \text{ m/s}}{14000 \text{ s}^{-1}} = 2.45 \text{ cm, ~1 in tweeter} \)

c) \( \lambda = 24.5 \text{ cm, ~10 in subwoofer} \)

d) Just like sound waves arriving to an observer out of phase if the speaker exceeds the wavelength, so does scattered light waves bouncing off a molecule larger than the wavelength.