GrapheneQ: a commercially available material for the new generation of consumer audio

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Most audio drivers produce sound by moving a membrane that pushes the air to generate pressure waves. The membrane suffers from an inevitable compromise when balancing its stiffness and weight. On one hand, a lack of stiffness results in speaker break-up - the membrane deforms in standing waves at certain frequencies resulting in distortions. On the other hand, the diaphragm must be lightweight for a fast response and more efficient sound generation.

ORA invented a new material– GrapheneQ – which outperforms commonly used acoustic materials thanks to the rare combination of low density and high stiffness, damping and thermal conductivity. GrapheneQ is a composite multilayer material based on graphene oxide. Graphene layers are cross-linked with proprietary additives for better stiffness, flexibility and environmental stability.

The material can be deposited directly into different desired sizes and shapes (such as cones, domes and flat membranes) with tight tolerances. ORA has already started mass production of their GrapheneQ membranes and offers the technology for adoption by the consumer electronics industry.

In our talk we will discuss how the properties of the material can be tuned for specific applications by varying the material formulation and the processing conditions.

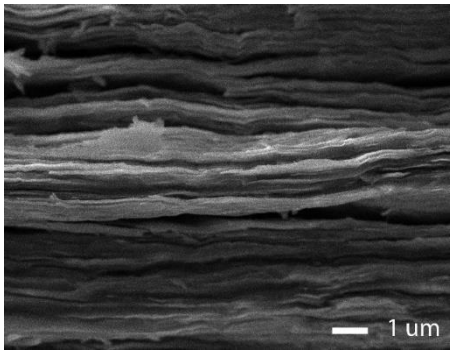

Figure 1: cross-section SEM image of GrapheneQ

Figure 2: photo of a 3" loudspeaker membrane

	Young's modulus **E** (GPa)	Density **ρ** (g/cm³)	Loss factor **tan δ**	Speed of sound **v** (m/s)	Poisson's ratio	Thermal conduct. (W m⁻¹ K⁻¹)	FOM $\sqrt{\frac{E}{\rho^3}}$	Cost (order of magnitude)
Aluminum	70	2.7	0.002	5091	0.36	240	1.89	$$
Titanium	113	4.5	0.002	5011	0.34	19	1.11	$$
Beryllium	300	1.85	0.002	12734	0.02	216	6.89	$$$
Paper	2.2	0.8	0.034	1658	0.20	--	2.07	$
Mylar	3	1.39	0.020	1469	0.40	0.15	1.06	$
GRAPHENEQ	**45**	**1.6**	**0.055**	**5303**	**0.18**	**102**	**3.32**	**$$**

Table 2: comparison GrapheneQ to the commonly-used acoustic materials.