A Bio-Inspired Low-Noise Differential Microphone with Optical Detection

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Abstract:
A bio-inspired directional microphone is being developed that has extremely low thermal and electronic noise. The dramatic reduction in the noise of these directional microphones will be accomplished by the integration of a previously developed low-damping, hence low-noise microphone diaphragm, a revolutionary low-noise optical method for converting the motion of the diaphragm into an electronic signal, and the use of electronic feedback to incorporate electronic damping to achieve the desirable response benefits of damping without the associated thermal noise. The 1 mm by 3 mm polysilicon directional microphone diaphragm has very low damping and high sensitivity to sound. The optical scheme provides a highly sensitive method of obtaining an electronic output from the microphone diaphragms that adds negligible electronic noise. The invention of the biomimetic differential microphone diaphragm and the optical sensing scheme made it possible to use electronic feedback to actively control the microphone response without increasing thermal noise [1-6].

Research Summary:
Bio-inspired miniature polysilicon directional microphones with optical detection gratings have been successfully fabricated. The optimized microphone diaphragm is 1 mm by 3 mm made by phosphorous doped polysilicon reinforced with 30 µm tall, 2 µm wide stiffeners. Optical gratings are incorporated at the ends of the microphone diaphragm.

A 10 µm thick 5% phosphosilicate glass (PSG) layer is deposited to define the gap between the microphone diaphragm and the 5 µm thick gold reflective mirrors above the optical gratings. Initial acoustic testing shows that the microphone diaphragm responds as predicted.

Figure 1 shows the L-Edit image of the optical sensing differential microphone with gold mirrors. The SEM image of the fabricated optical sensing differential microphone is shown in Figure 2. Figure 3 shows the close-up SEM image of the optical gratings at the ends of the polysilicon microphone.

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References:


