Engineering a Novel Atomic Force Microscopy Based Nano-Stethoscope

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The stethoscope has been one of the most important tools in medical practice for centuries but has a limit on how small of a sound it can detect. An atomic force microscope (AFM) can be used in practice as a physical stethoscope. Novel acoustical filters were built to remove obtrusive frequencies from target frequencies so that the sensitive AFM cantilever could be used to measure the amplitudes of nanoscale sound waves. The prototypes of filtration were designed and modeled on tinkerCAD software, printed and assembled with the dimensions carefully assessed, and built in the structure of combined band-stop/low-pass filters with diameters of 30, 50, and 100mm. They were then assembled and tested with a sound pressure lever to gauge their efficiency, by comparing the ratio of decibel input to decibel output over a range of 0-10000Hz. The optimal frequency for the 30mm low-pass filter was calculated to be 5300Hz based on the acoustic filter equations, and when tested, it was found to be at 5000Hz. The optimal frequency for the 50mm band-stop filter was calculated to be 3250Hz based on the formula, and the testing frequency was found to be 3000Hz, indicating that these models represented the equations properly with a minimal sound loss. The next step would be to test the AFM under aquatic conditions to improve the sound flow within the system. This revisit of the stethoscope opens up new possibilities for physicians, as the filters have the significant practical applications of both acoustical filtration and disease detection.

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