

## **Can Integrated Ultrasound/Photoacoustic Systems Deliver on the Promise of Molecular Medicine?**

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For over two decades, microbubble-based contrast agents have been used extensively in biomedical ultrasound. Recent advances in molecular engineering have produced microbubbles targeted to specific molecular biomarkers, especially in the vasculature. Over the same period, parallel advances have been made in the field of photoacoustics in which molecular processes can be directly probed using the mechanism of optical absorption with ultrasonic (US) readout similar to a conventional real-time imaging system. Photoacoustics (PA) brings molecular sensitivity to US imaging for many biomedical applications using nano-scale, bioconjugated contrast agents. In addition, both US and PA agents can potentially be used for molecularly-targeted therapies, opening the possibility for molecular theranostics using integrated US/PA systems.

Although much progress has been made in recent years, there is still not a routine clinical procedure using US/PA for molecular theranostics. If recent advances in molecular engineering and molecular biomarker discovery are to be exploited for real clinical applications, many US/PA technologies must be translated into clinical tools. In this talk, we will explore recent advances in the field and discuss current obstacles to clinical translation. Finally, we will discuss how US/PA molecular theranostic technologies can accelerate the transition to personalized medicine and effective healthcare delivery.