Despite significant associated risks, limited awareness and insufficient treatment of hypertension persists in both resource-limited and wealthy regions. Self-measurement of blood pressure (BP) is promoted to reduce prevalence of hypertension. However, current technologies for BP measurement present several limitations to widespread adoption of the strategy. The common high-pressure cuff-based devices can be cumbersome and uncomfortable, have limited time resolution of at least 1-2 minutes, and are unsuited for ambulatory or mobile health monitoring platforms.

These barriers can be overcome by employing organic electronic techniques developed in the Bao group which will enable increased sensitivity, miniaturization, cost reduction, and low power consumption in next generation pressure sensors. Organic electronic approaches are well suited for manufacturing via roll-to-roll printing processes, enabling low cost, large-scale production of sensors. Our overall goal is to develop a potentially low cost, wireless wearable blood pressure sensing patch to enable frequent self-monitoring. This wireless pressure sensing platform can then be easily extended into other pressure sensing applications including environmental, supply chain, and consumer goods monitoring.

The patch comprises of two main components: the pressure transducer and the wireless communication chip. The transducers consist of a microstructured rubber layer sandwiched between electrodes formed by evaporating metal onto a plastic substrate. High conformity is achieved by adding micropillar structures at the interface between the sensor and the epidermis. The pressure transducers are uniquely able to detect pulse waveforms by simply placing the transducer on the epidermis over an arterial site. The pulsation of the underlying artery imparts a deflection on the transducer that causes a change in capacitance. We are currently optimizing the existing epidermal pressure transducers for blood pressure measurement by implementing transducer arrays and tuning dielectric properties.

A barrier to the development of novel sensors for wearable sensing application is the large hurdle presented by integrating wireless capabilities to assess true performance of the sensor under mobile situations. Wireless integration will enable our device to be wearable and suitable for robust ambulatory testing. We are working on integrating our transducer with the Near Field Communications platform to achieve low cost data transmission and logging. An NFC enabled smartphone serves as the NFC reader, which
automatically receives data from in range NFC tags. While the NFC tags are theoretically capable of harvesting energy from the smartphone, in the initial stages thin film batteries power the device. To create the tags, the transducers are integrated with AMS SL13A chips. The analog to digital converter on each tag quantizes the signal from the pressure transducer and transmits the data via an antenna. A smartphone app will then receive the data and calculate and log the blood pressure measurement.

This research will leverage a uniquely sensitive and flexible pressure transducer to achieve the first low cost, wearable blood pressure monitoring patch. It will also provide a guiding protocol for developing a sensor technology into a fully integrated, wireless data monitoring system using NFC technology. Enabling self-monitoring of blood pressure would revolutionize the detection and treatment of hypertension, a global health problem. Furthermore, the sensor-NFC smartphone platform can be easily extended to an array of other sensing applications such as environmental or consumer goods monitoring.