# Smart Cardiovascular Stent against In-Stent Restenosis

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**Abstract:** A smart cardiovascular stent to be used as a single set of theranostics (therapeutics and diagnostics) is developed. The stent is aimed at delivering nitric oxide as a therapeutic agent and monitoring stent-induced restenosis. This novel approach is intended to reduce the risks stemmed from implanted stents and lowering manufacturing cost. The proposed stent will provide a non-invasive and continuous monitoring of restenosis caused by the stent. To assess the level of restenosis, pressure and blood flow will be monitored inside the blood vessel where the stent is placed. Existing techniques that employ catheters to measure pressure inside blood vessels are not suitable because they are too invasive, cannot monitor pressure for long periods of time and restrict the patient to be in a hospital setting. Our approach consists of two miniature pressure sensors and a small microchip incorporated into the stent. The pressure sensors are placed at the opposite sides of the stent. Blood flow is obtained by assessing the pressure difference at these two points. The microchip reads out the pressure sensors outputs and wirelessly transmits them to a reader outside the body. Due to size constraints and safety reasons a battery cannot be used as a power source for the microchip. Instead, power is provided from the reader via electromagnetic coupling. In order to reduce the number of components to be implanted, we are proposing to employ the stent body not only as a mechanical supporter but also as an antenna. To provide an optimal power match between the microchip and the antenna, the impedance of the stent was fully characterized. This characterization has been performed using computer simulations of five different commercially available stent designs. It was found that at the frequencies of interest (902 to 928 MHz) the impedance is highly reactive. To compensate for the reactive impedance of the antenna, a matching network was designed. A prototype microchip with different components has been designed and is currently being fabricated. Future work includes micro-assembly of a prototype

stent for the collection of pressure measurements using an aortic bifurcation model. Once completed, this stent will be useful in monitoring the level of restenosis and will lower the risks presented by implantable stents.