Selective oxidative functionalization of molecules is a highly relevant and often demanding reaction in organic chemistry. The use of biocatalysts allows the stereo- and regioselective introduction of oxygen molecules in organic compounds at milder conditions and avoids the use of complex group-protection schemes and toxic compounds usually applied in conventional organic chemistry. The identification of enzymes with the adequate properties for the target reaction and/or substrate requires better and faster screening strategies. In this manuscript, a microchannel with integrated oxygen sensors was applied to the screening of wild-type and site-directed mutated variants of naphthalene dioxygenase (NDO) from *Pseudomonas* sp. NICB 9816-4. The oxygen sensors were used to measure the oxygen consumption rate of several variants during the conversion of styrene to 1-phenylethanol. The oxygen consumption rate allowed the distinguishing of endogenous respiration of the cell host from the oxygen consumed in the reaction. Furthermore, it was possible to identify the higher activity and different reaction rate of two variants, relative to the wild-type NDO. The meander microchannel with integrated oxygen sensors can therefore be used as a simple and fast screening platform for the selection of dioxygenase mutants, in terms of their ability to convert styrene, and potentially in terms of substrate specificity.