# Method to express olfactory receptors for ultra-high sensitivity detection of odorants and other volatile chemicals

## Unmet Need

Artificial sensors for sight and sound are so ubiquitous that we frequently take them for granted. Whenever we ask Siri, join a conference call, or walk through an automatic door we benefit from sensors that transduce visual and auditory stimuli. These sensors are also being applied for safety monitoring, manufacturing quality control, and medical diagnostics. Many of these applications would be best served by sensors for smells, but existing smell sensors are not even as sensitive as the human nose. Current state of the art smell sensors can detect 0.5ppb (part per billion), whereas a person with a well-developed sense of smell can detect 0.01ppb. This 50-fold discrepancy is testament to the power of our olfactory receptors (ORs). Smell sensing technologies would benefit from adopting our naturally occurring smell sensors, but it is challenging to express ORs in non-olfactory cells. Heterologous expression, or expression of the receptor in non-native cells, is desirable because olfactory cells do not divide. To produce scalable next generation smell sensors, there is a need for methods to improve the heterologous expression of ORs.

## Technology

Duke inventors have developed a method to improve heterologous expression of ORs. This is accomplished by designing synthetic ORs whose amino acid sequence is optimized for high cell surface expression in non-olfactory cells while retaining proper OR folding and function. This is intended to be used for next generation smell sensors with improved sensitivity and selectivity. Specifically, the increased cell surface expression is accomplished by identifying amino acid sequences that

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Molecular Genetics and Microbiology

## Publication(s)

## External Link(s)

- From the lab of Dr. Hiroaki Matsunami

lead to improved trafficking of various human olfactory receptor subfamilies. This method is generalizable to any olfactory receptor type and expression system. This has been demonstrated with a variety of human and murine OR families (18 and 34 families, respectively) expressed in a variety of heterologous systems (including HEK293T and Hana3A cell lines).

## Other Applications

This technology could also identify an unknown odorant by measuring its activation of known olfactory receptors. Additionally, smell sensors will also be integral components of devices that produce olfactory stimuli, such as virtual/artificial reality devices integrating smells. Devices that trigger and augment smells will require an automatic feedback system similar to that of a digital screen that utilizes a light sensor to automatically adjust brightness to match the level of ambient light. Such devices could be utilized in entertainment and healthcare.

## Advantages

- Increased sensitivity (50-fold) over existing smell sensors
- Expression of olfactory receptors in non-olfactory, dividing cell lines

Generalizable method can be applied to any olfactory receptor expressed in any cell-line