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- Comment on: "Dissolved oxygen sensing characteristics of plastic optical
 fiber coated with hydrogel film" The wider context of fibre optic oxygen
 sensing.
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5 Authors: Federico Formenti ^{1, 2, 3, @}

- ¹ Centre for Human and Applied Physiological Sciences, Faculty of Life Sciences
 and Medicine, King's College London, London
- ² Department of Biomechanics, University of Nebraska Omaha, Omaha, NE, USA
- ³ Nuffield Division of Anaesthetics, University of Oxford, Oxford, UK.

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- 11 @ Corresponding author: Dr Federico Formenti <u>federico.formenti@outlook.com</u>
- 12 Centre for Human and Applied Physiological Sciences, Faculty of Life Sciences and
- 13 Medicine, King's College London, London SE1 9UL

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Author Contributions: FF conceived the study, interpreted the data and approved
 the final manuscript.

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- 19 Research (UK), the National Association of Academic Anaesthetists, and the
- 20 Wellcome/EPSRC Centre for Medical Engineering; he is one of the directors of
- 21 OxVent, a joint-venture social enterprise between Oxford University and King's
- 22 College London for mechanical ventilation.

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27 Abstract:

A recently published article by Bian et al. [1] presents a novel plastic optical fibre 28 coated with hydrogel film to measure dissolved oxygen via luminescence quenching. 29 30 The article concludes that "The sensor with biocompatible material is expected to be applied to the monitor of dissolved oxygen in the domain of biomedicine". However, 31 the oxygen sensor presented contains ruthenium, a toxic material that is considered 32 unsafe for clinical applications. It is unclear whether the hydrogel film coating may be 33 sufficient to prevent direct contact between ruthenium and human tissue in clinical 34 35 applications. However, platinum porphyrin has been used in fibre optic oxygen sensors in pre-clinical applications. This Comment article provides a brief overview 36 of some platinum porphyrin-based fibre optic oxygen sensors that, despite an 37 advanced degree of maturity and biocompatibility, were overlooked in the recently 38 published article. 39

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42 The recently published study Dissolved oxygen sensing characteristics of plastic optical fiber coated with hydrogel film [1] presents a novel methodological approach 43 to manufacture a plastic optical fibre oxygen sensor based on the luminescence 44 quenching principle, with a response time of 10 s. This response time is sufficient for 45 some applications, but thick hydrogel coatings limit the rate of oxygen diffusion; in 46 this sense, thin sol-gel coating films offer a shorter response time, enabling the 47 monitoring of biological phenomena that change within less than one second [e.g. 48 12]. The study mentions that the oxygen sensor is composed of biocompatible 49 materials, and concludes that it "is expected to be applied in biomedical field". 50 However, the luminescence indicator used in this new oxygen sensor is ruthenium 51 that, being toxic, was reported as unsafe in the clinical setting [2]. The toxicity risk 52 could be mitigated with the application of protective coating to the fibre (when rapid 53 response time is not crucial for the application), and successful completion of 54 leaching studies in the biologically relevant context, for example at the relevant 55 56 temperature and humidity. This limitation has so far impeded the translation of this promising technology to a clinical setting [3,4], where rapid and/or continuous 57 oxygen sensing could be helpful, for example for patient monitoring [5]. Indeed, 58 several other luminescence-based fibre optic oxygen sensors have been developed 59 (e. g. [6–9]). 60

To overcome the translational limitation associated with the use of ruthenium in fibre optic oxygen sensors, different research groups have employed a platinum porphyrin luminophore [10] aiming at different clinical applications, for example the assessment of the compartment syndrome [11], and to determine ventilatory oscillations in arterial blood oxygen tension [12]. These studies employing the platinum porphyrin luminophore have demonstrated a very rapid response time ~100 ms and maturity

beyond the initial bench testing [13], including experiments to determine the sensors' resistance to clotting in blood [14], and several pre-clinical experiments that enabled unprecedented measurements *in vivo* in sheep [15] and pig models of the acute respiratory distress syndrome [16], providing a new tool to measure lung volume [17], and with the potential to investigate cardiopulmonary function [18,19].

The novel fibre optic oxygen sensor coated with hydrogel film [1] was presented 72 largely in the context of ruthenium-based oxygen sensors (e. g. [20,21]). Whether the 73 hydrogel film is sufficient to isolate the ruthenium from human tissues appeared 74 unclear, as did the potential risks associated with the disconnection of the film from 75 the fibre. The studies employing the platinum porphyrin luminophore for oxygen 76 sensing, which appear to have reached relative maturity, were overlooked. The 77 majority of these studies, the sensors' development and some of their potential 78 clinical applications have been recently reviewed [22,23]. 79

80 Overall, to facilitate translation of studies to the clinical setting, a greater interaction 81 between photonics technology developers and clinicians is required.

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