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Paper-based microfluidics for typing of primary and secondary human blood groups in "text"

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Blood groups have been considered the best human genetic markers for many years since they carry a significant amount of information for mapping the human genome. The discovery of the ABO blood group has first made blood transfusion feasible. The later discovery of the RhD antigens has led to the understanding and subsequent prevention of haemolytic disease of the newborn (HDN). To date, 30 blood group systems, including the primary blood groups-ABO, RhD-and other secondary blood groups, have been classified. Each of these blood groups contains unique sub-type antigens and the correct typing of the human blood groups is clinically significant in blood transfusion and blood banking. Patterned bioactive paper and other low-cost bioactive materials have become platforms for making low-cost and user-operated devices for diagnosis. The potential of this platform to deliver affordable, rapid, and user-friendly diagnostic sensors in the developing countries has become increasingly clear. Research to date has successfully generated a few blood typing devices and diagnostics. However the major requirements for new generation of home- or field-based blood typing sensors are that they must be able to rapidly and unambiguously report the blood typing result to non-professional users. Therefore this work utilises paper and printing technologies in combination with biochemistry and haematology to explore engineering designs of a new class of diagnostic blood analysis devices. This work reports a break-through in design of a novel paper-based blood-typing device, which reports the blood-typing assay results with written text, instead of by visual observation of red blood cell agglutination. This novel device reports the assay result in an unambiguous way and does not require the users to have the knowledge to interpret their blood typing results from the first principle. This break-through significantly reduces the possibility of misinterpretation of the blood-typing assay; it makes this invention highly suitable for point-of-care products and for blood analysis in developing countries. This work can also potentially reduce cases of result misinterpretation in hospital bed-side tests in developing or even developed countries, which is a one of the leading causes of medical complications in blood transfusion.

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