# BLOOD SUBSTITUTE FLUID FOR EXPERIMENTAL FLOW VISUALIZATION IN INTRACRANIAL ANEURYSMS.

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## Introduction

In order to investigate blood flow in brain aneurysms, cerebral hemodynamics are modelled using computational fluid dynamics (CFD) and validated with experimental in vitro flow tests, in particular using particle image velocimetry (PIV) [1,2]. Since blood is intransparent, the laser light can only penetrate a few micrometers into the boundary flow. Thus, it is unsuitable for PIV measurements. The aim is to develop PIV-compatible blood substitute fluids that simulate the multiphase nature of blood (blood cells and blood plasma) and adapt rheologically to blood.

## Methods

The artificial erythrocytes (beads) are modelled with a microfluid systems (MKS) aiming for a diameter of 7 µm and a biconcave shape. The continuous phase is olive oil, the disperse phases are the hydrogel solutions. The beads consist of the natural hydrogel agarose and the photopolymer NOA60 [3]. In addition, PIV seeding particles (Polyamid spericals) are integrated into the beads to make them visible during the PIV measurements. The influence of fluid flow of the continuous and disperse phase on the diameter size of the beads and their monodispersity are investigated. The bead shape is formed by the flat design of the MKS channels (0.5 x 400 mm) [3]. The generated beads are separated from the oil by washing and sinking and finally transferred to a 36% (v/v) glycerol-water mixture. The visibility of the beads in the blood substitute fluids is analyzed in initial PIV experiments.

## Results

Several blood substitute fluids were successfully produced, including artificial plasma from a glycerol-water mixture, mixed with spherical and disc-shaped agarose beads as well as disc-shaped NOA60 beads. The smallest beads show diameters of up to 29 µm at a volume flow rate of 70 ml/h. Disc-shaped beads can be successfully synthesized with the flat channel structure (cf. fig. 1). The developed blood substitute fluids can be used for PIV measurements for 24 days with the agarose beads and for several months with the NOA60 beads. Initial PIV measurements showed that the agarose beads could only be tracked using the modified measurement method called shadow imaging.

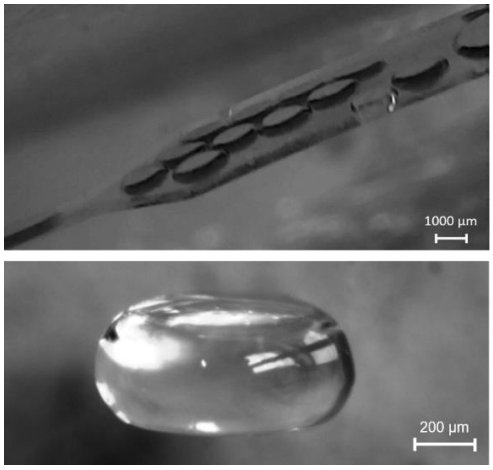


*Figure 1: Light microscopic images of the synthesized disc-shaped Agarose beads in MKS (above) and a disc-shaped NOA60 bead (below).*

## Discussion

The results show that multiphase blood replacement fluids could be successfully developed for PIV measurements. The size and quantity of the artificial erythrocytes produced will be optimized in further work. The blood replacement fluids can be used for future studies to investigate hemodynamics in brain aneurysms.

## References

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