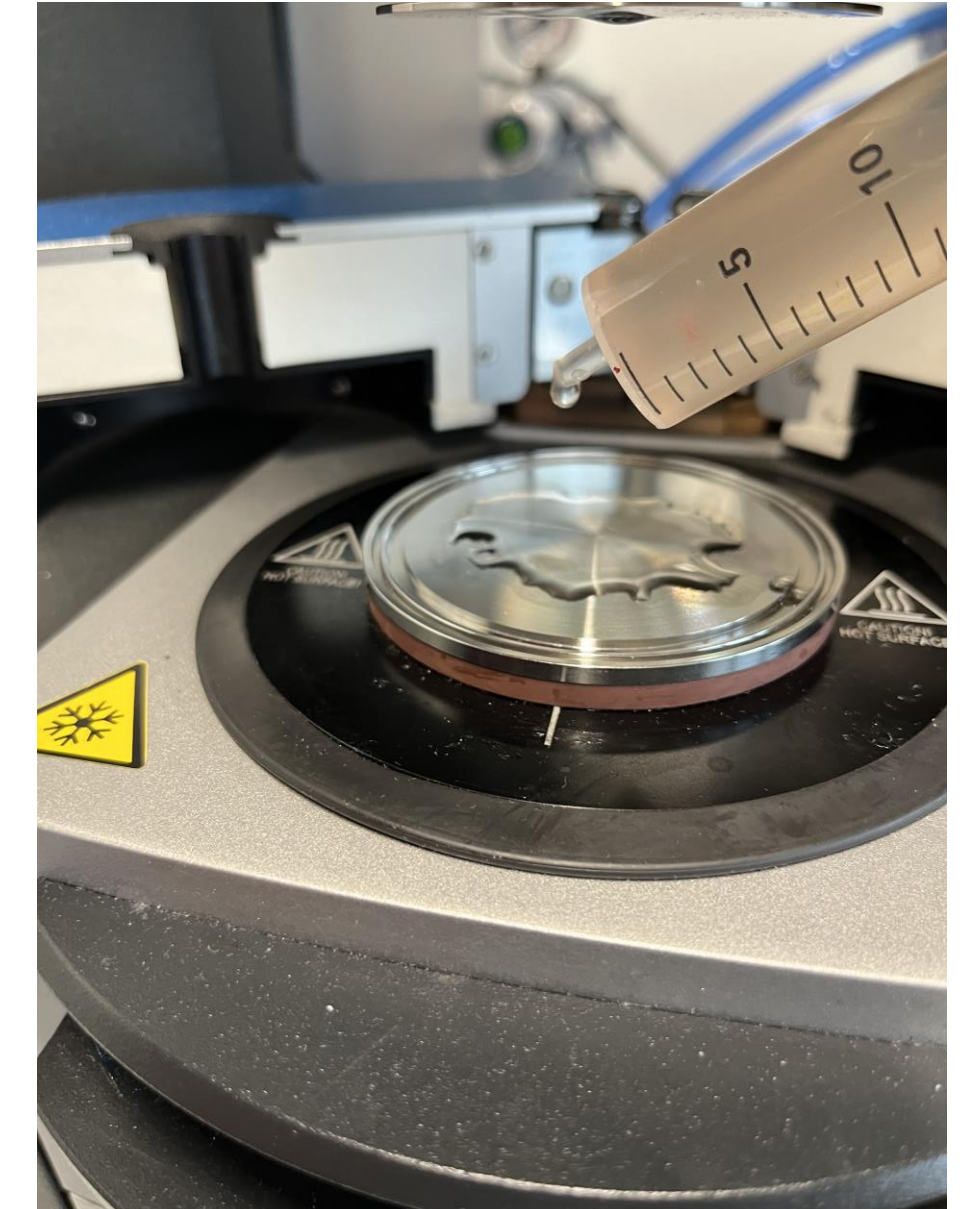


Developing Initial Rheological and Tribological Investigations of Pericardial Fluid

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Motivation

- Pericardial fluid is relatively understudied in terms of its rheological and tribological properties.
- Pericardial fluid is a lubricating fluid between the layers of the pericardium, the double-walled sac that surrounds the heart.
- Main function is to reduce friction between the heart and the surrounding tissues during the heart's constant pumping action.
- By reducing friction, the pericardial fluid allows the heart to move smoothly in the chest cavity during beating.
- It also protects the heart from physical shocks or blows.
- The pericardium and its fluid help to maintain the position of the heart and prevent overstretching due to excessive blood volume.
- The serous layer of the pericardium (specifically the visceral pericardium, also known as the epicardium) produces pericardial fluid.

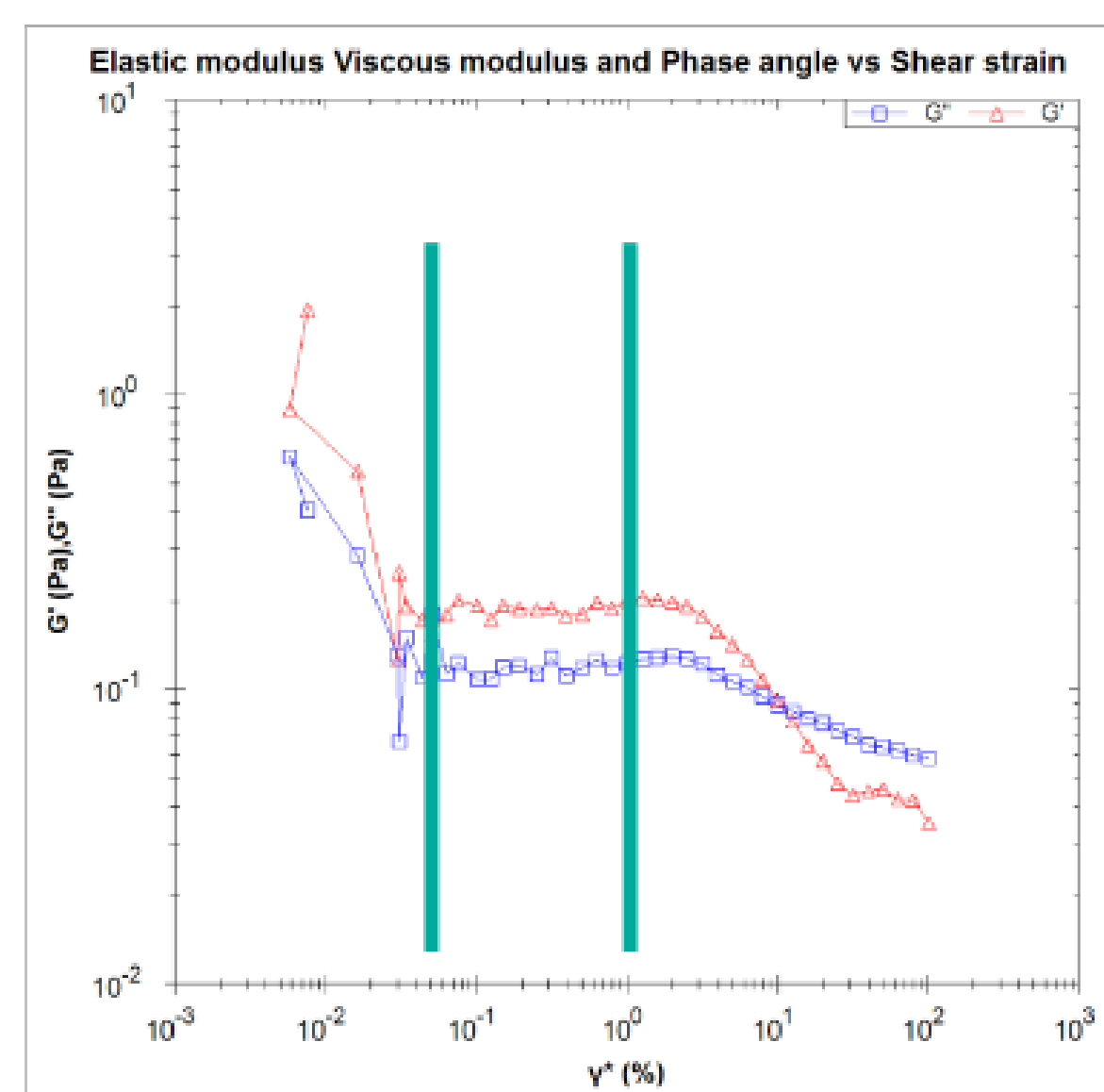


Pericardial fluid applied for investigations

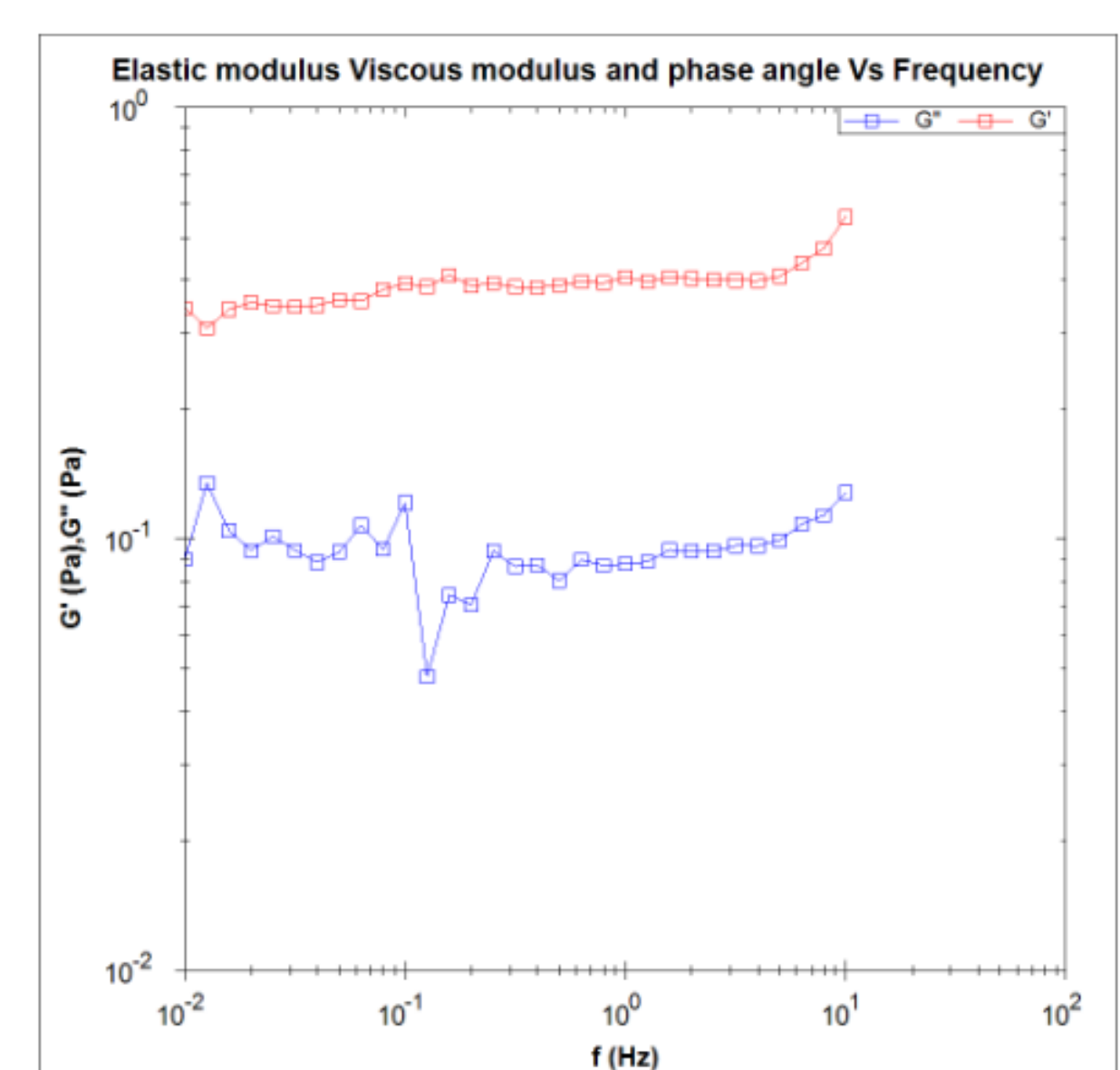
Rheological studies

Rheological investigations

- Fresh adult porcine pericardial fluid was analyzed within a few hours after extraction.
- Rheological properties were initially assessed at 25°C and 37°C using a 1° cone with a 60 mm diameter against a plate.
- The shear viscosity was measured as a function of shear rate, complemented by amplitude and frequency sweeps.



Determination of possible deformation for frequency sweeps

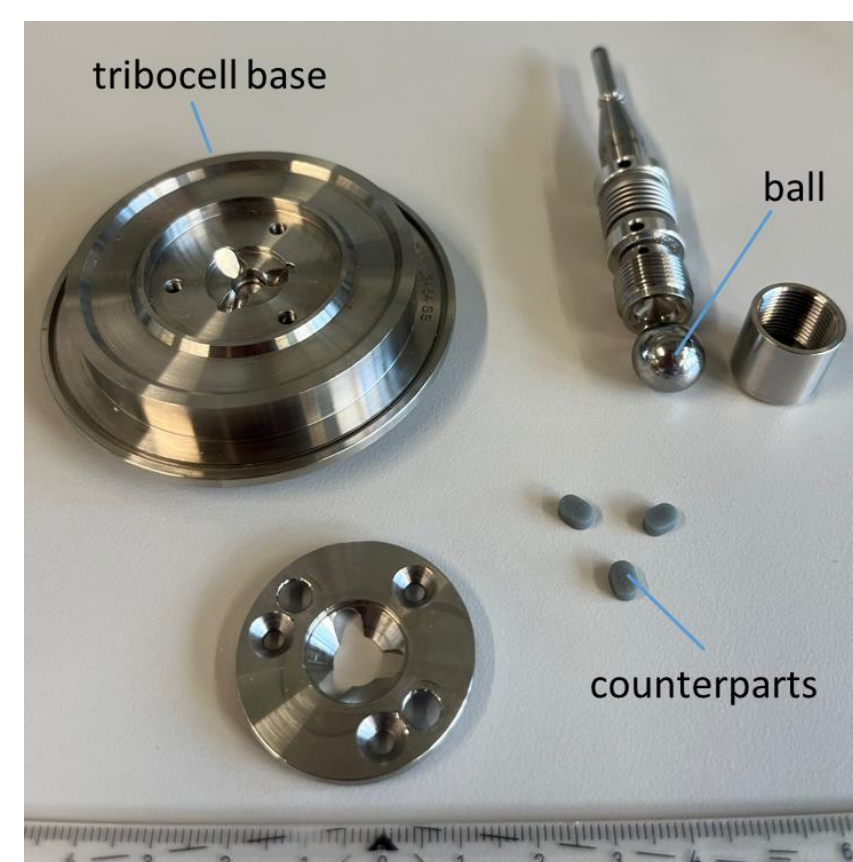


Frequency sweep in strain control at 0.5 % deformation

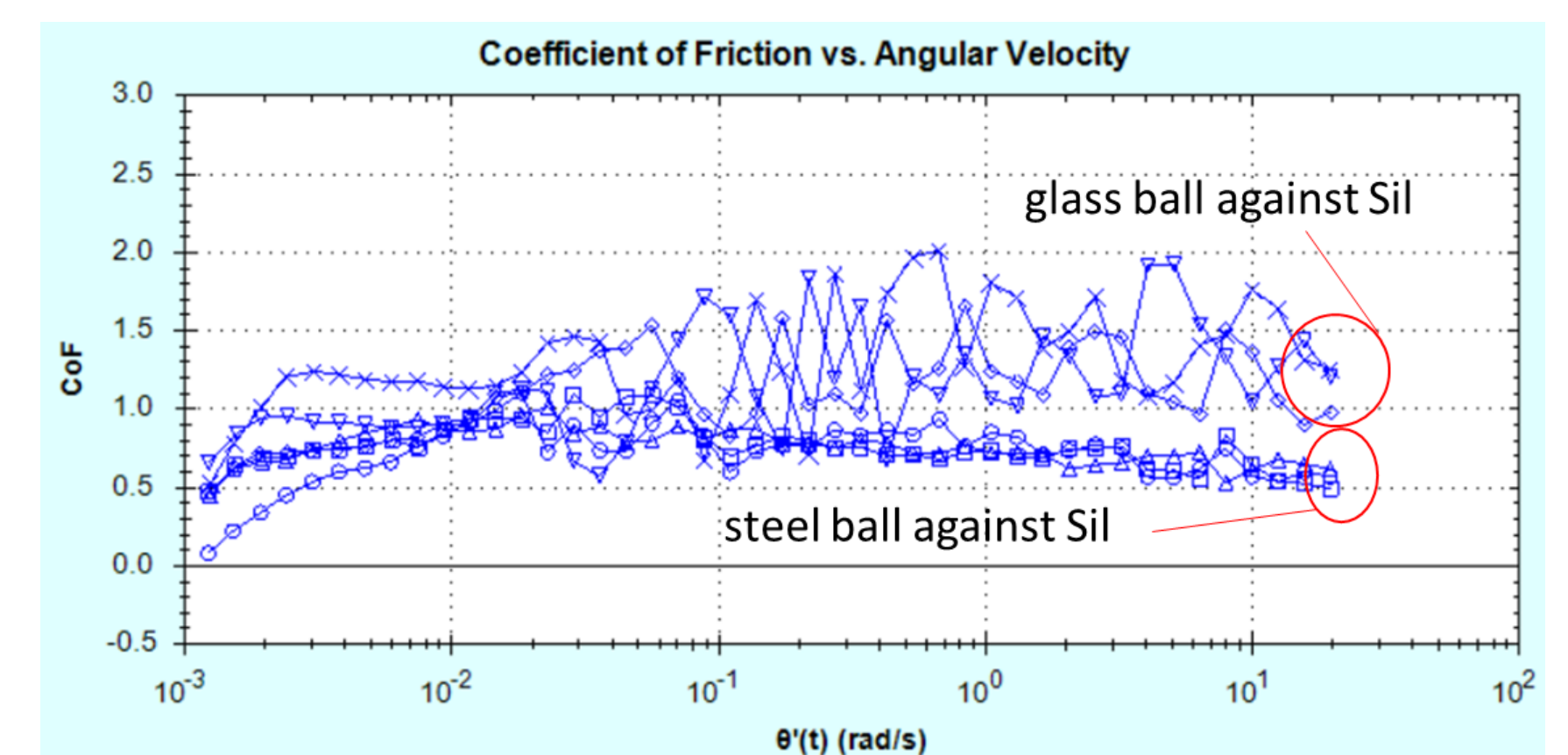
Tribological studies

Tribological investigations

- To explore the frictional properties, tribocell tests were conducted using a rotating ball in contact with three silicone counter bodies.
- The ball-on-three-pins setup consisted of a steel ball measuring 12.7 mm in diameter and three elastomeric pins made of SIL 30 silicone urethane elastomer.
- A normal load of 1 N was applied to the ball to create a narrow gap between the ball and the counterpart surfaces.
- Extended Stribeck curve measurements were performed with increasing angular velocity from approximately 1×10^{-3} rad/s to 20 rad/s.



Tribocell components



Frictional properties of pericard fluid in Tribocell

Summary

- In terms of viscosity, the modulus G' (storage modulus) was greater than the G'' (loss modulus) across over the wide frequency range.
- The frictional properties were found to be comparable to those of blood plasma.
- These measurements represent the initial step in characterizing the rheological and tribological properties of pericardial fluid and provide important data for future simulations of interactions between the pericardium, pericardial fluid, and the heart.