# PERIODIC SHAPE CHANGES IN MODIFIED BELOUSOV-ZHABOTINSKY DROPLETS

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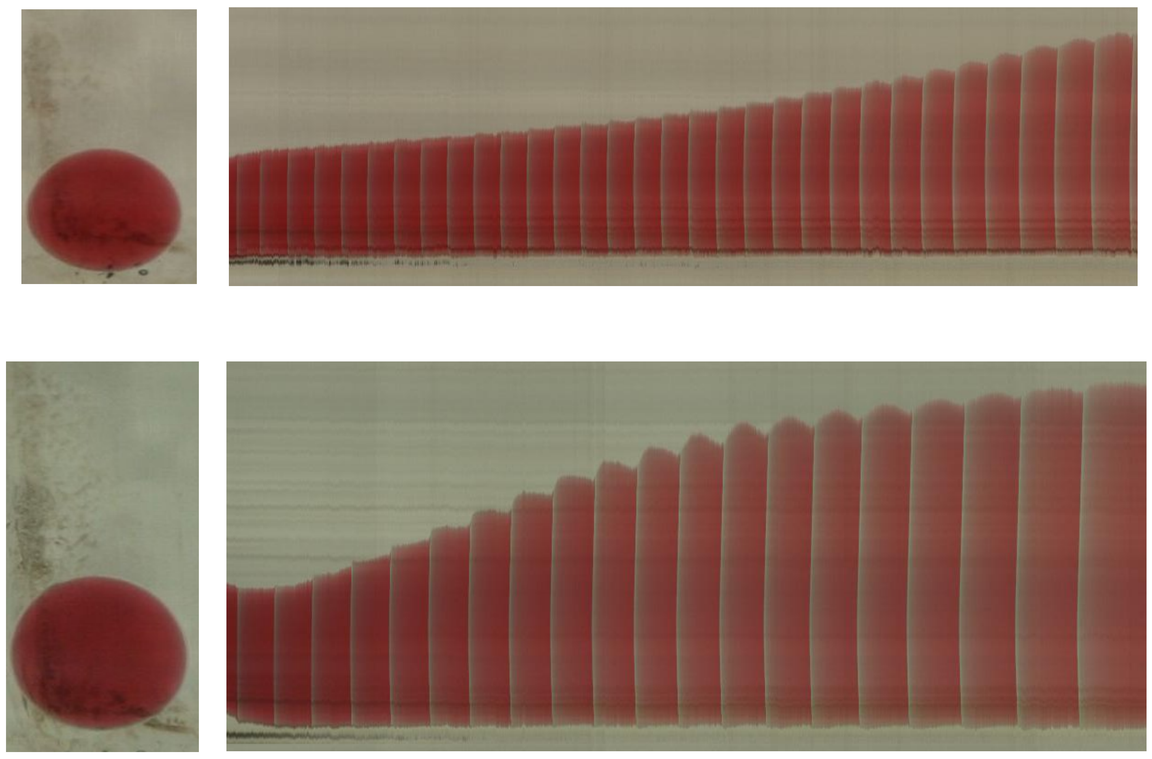
## Abstract

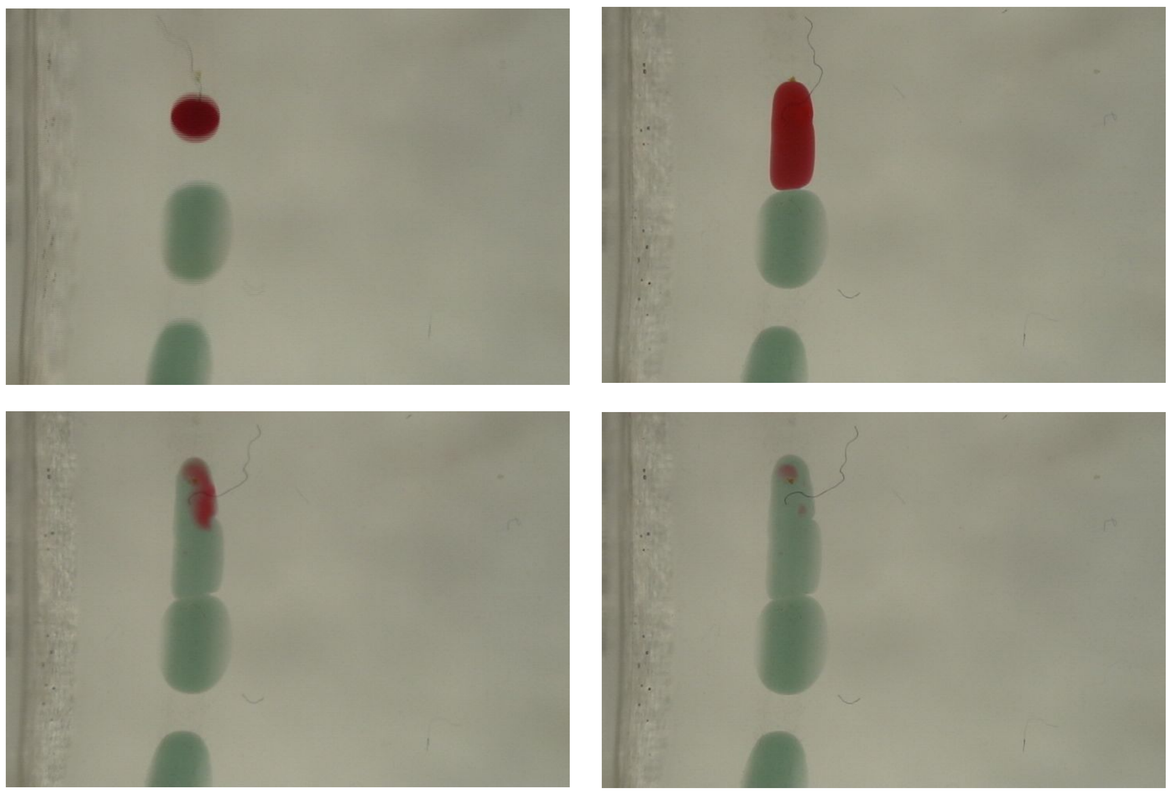
We report shape changes in aqueous droplets containing the reagents of the Belousov-Zhabotinsky reaction. When the droplets are placed in a trench under an organic phase composed of solution of phospholipid extract in decane, they undergo periodic shortening and lengthening in phase with the chemical oscillations. The observed phenomena are explained in terms of interactions of a modified reaction catalyst with the polar groups in the lipid molecules, which influences the surface tension of the droplets.

## The shape changes



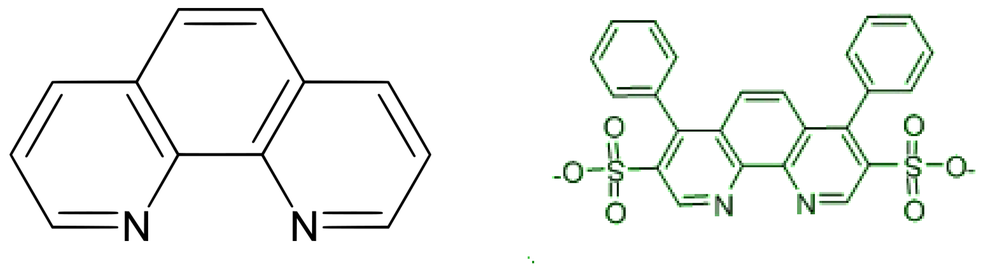
Space-time plots showing changes in shape for aqueous droplets containing the reagents of the Belousov-Zhabotinsky reaction. The horizontal axes cover 50 minutes, the initial droplet diameter is 2 mm. The BZ solution composition: 0.6 M sulphuric acid, 0.1875 M $NaBrO_3$, 0.175 M malonic acid, 0.06 M KBr, 1.7 mM bathophenanthroline disulphonate iron(II) complex. The organic phase is composed of solution of phospholipid extract asolectin dissolved in decane in concentrations 0.5 mg/ml (**A**) and 5 mg/ml (**B**).

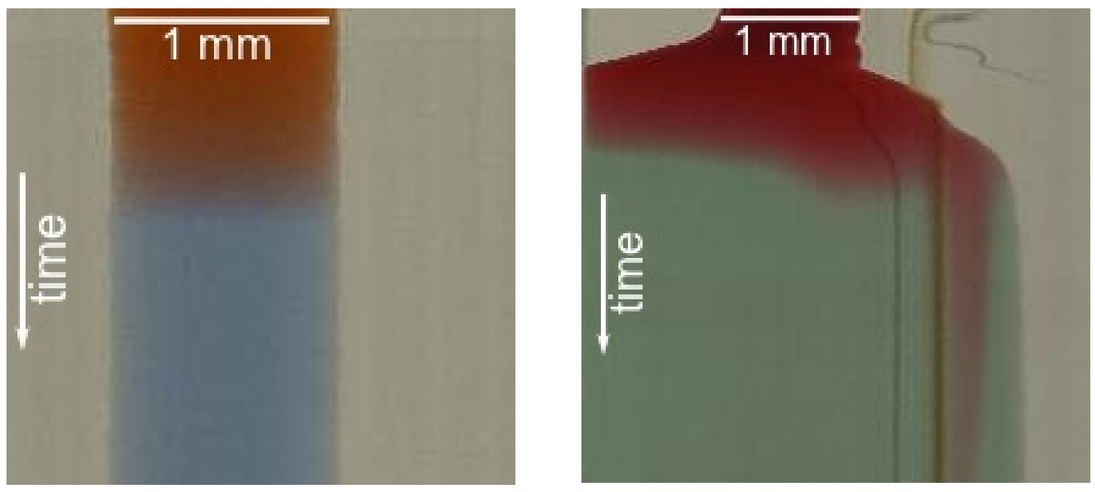
## Catalyst oxidation in a droplet



Left to right, top to bottom: consecutive stages of catalyst oxidation in a droplet placed in a trench and containing 0.3 M sulphuric acid, 4.9 mM bathophenanthroline disulphonate iron(II) complex and small amount of $NaBrO_3$. The frames are separated by 18 seconds.

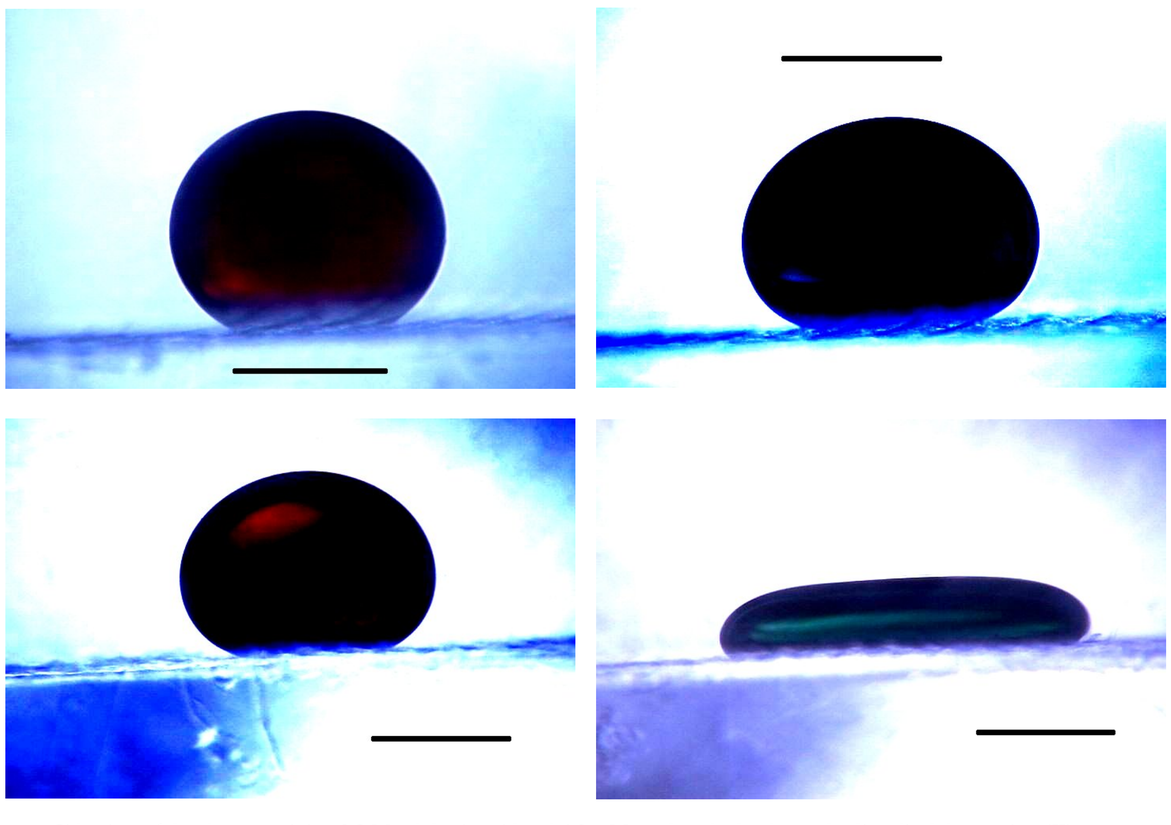
## Influence of the modified catalyst




Space-time plots showing oxidation in droplets containing 0.3 M sulphuric acid, 4.9 mM catalyst - ferroin (**A**) or bathophenanthroline disulphonate iron(II) complex (**B**) - and small amount of $NaBrO_3$. The vertical axes cover ca. 90 seconds; the droplets are placed in a trench in a plexiglass vessel. The structures of the respective catalyst ligands are shown above the snapshots.

## Surface interactions



Side view of droplets containing 0.3 M sulphuric acid and 4.9 mM catalyst, bathophenanthroline disulphonate iron(II) complex, placed on a flat plexi surface, before (A, C) and after (B, D) the addition of 20 µl of 1.5 M NaBrO3. The surrounding decane phase contained either no lipids at all (A, B) or 5 mg/ml asolectin (C, D). The scale bars are all 1 mm.

## Discussion and conclusions

The modified catalyst, which was originally used due to the better colour contrast it provides as compared with the original 1,10-phenanthroline complex [1, 2], differs from it in the presence of additional polar groups. As the phospholipid molecules possess polar heads, there is a possibility of interactions between the lipid layers and the catalyst molecules. These interactions, changing in character with the oxidation state of the catalyst, change the properties of the lipid layer, specifically its surface energy, which makes the droplet less capable of keeping its original shape.

### Acknowledgment

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### References: