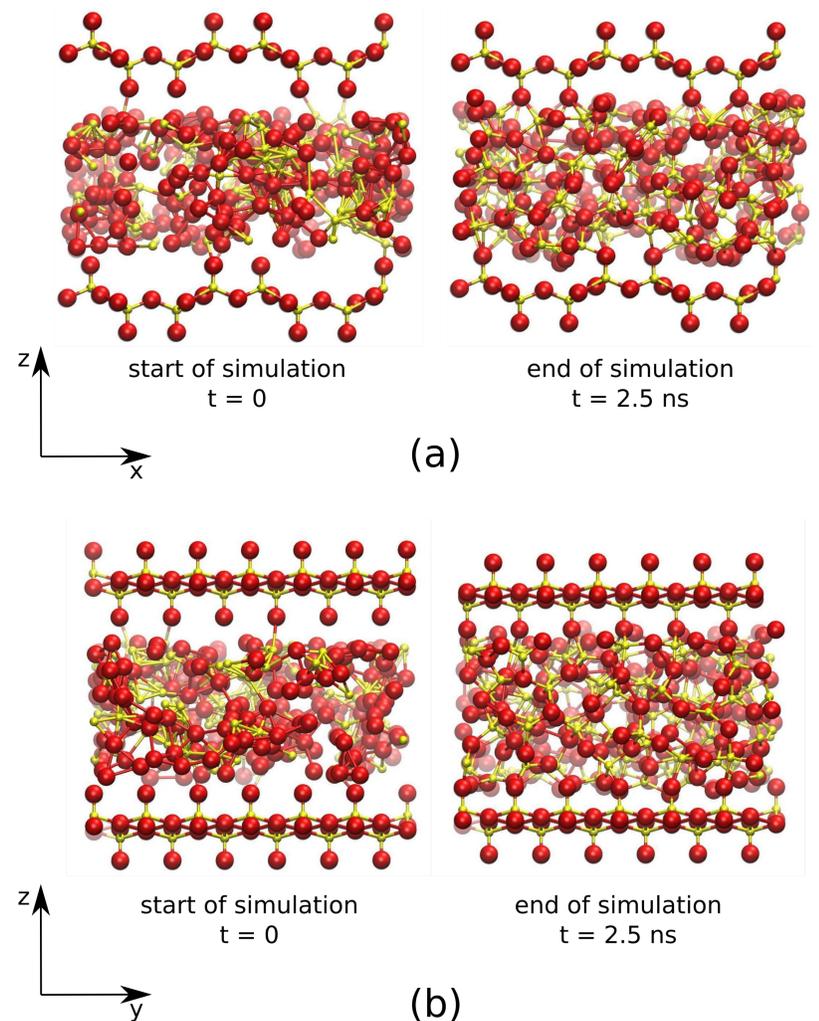


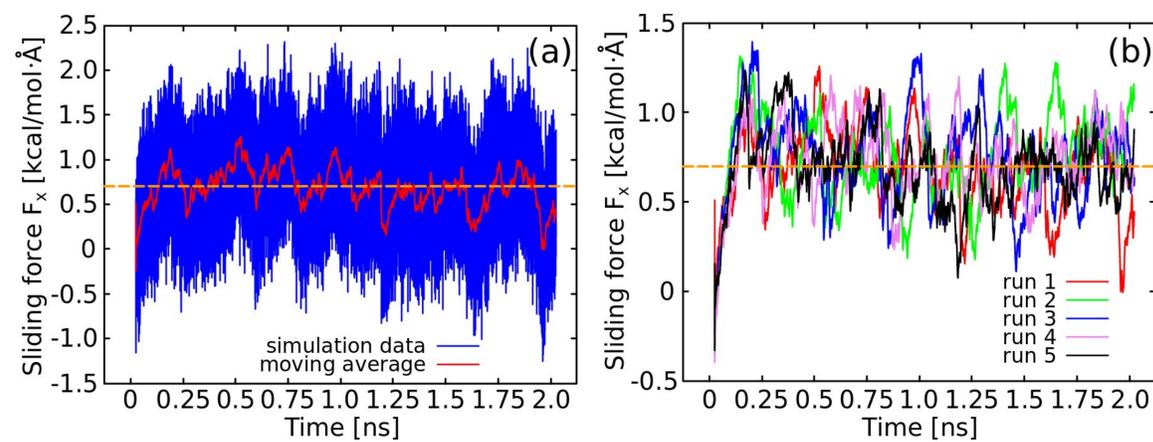
## Introduction

- Friction** accounts for the losses of approximately one quarter of the global energy production. Providing **effective lubrication** at high temperatures and pressures and under oxidation is relevant for turbomachinery, machining tools, aerospace industry.
- Hard and oxidation-resistant coatings** consist of binary or ternary films (Cr-N, Ti-N, Cr-Al-N, Ti-Al-N) doped with an additional element. **Vanadium** gained popularity since its oxides **reduce friction** and they melt at relatively low temperatures, hence providing **liquid lubrication**.
- Vanadium diffuses to the surface of the coating, reacts with oxygen and forms an oxide of a certain **stoichiometry** ( $V_xO_y$ ) which serves as a lubricant. The motivation of our research: how does the **stoichiometry** impact the **tribological properties** of  $V_xO_y$  lubricants, under the aforementioned conditions.

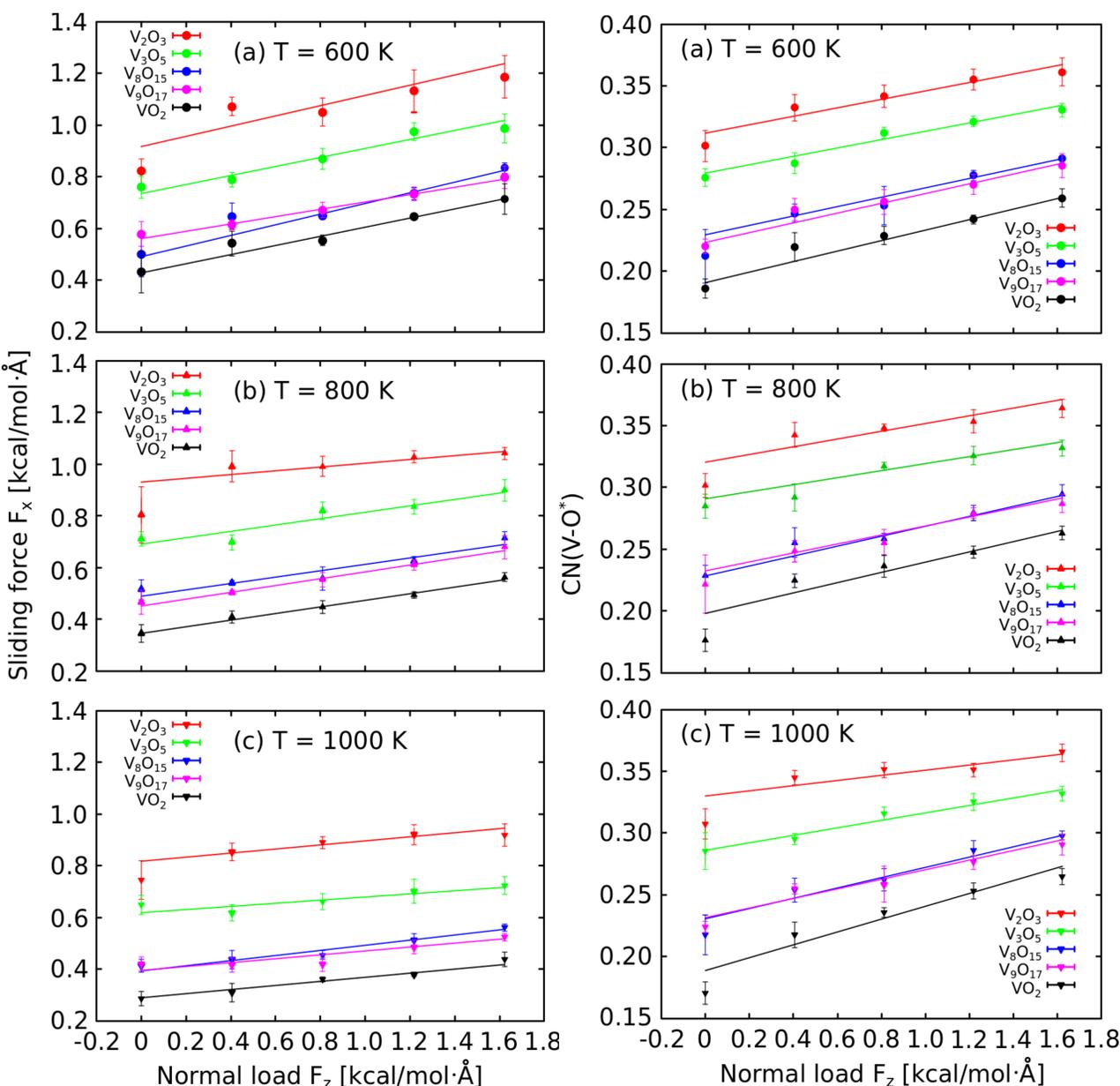
## Simulation setup



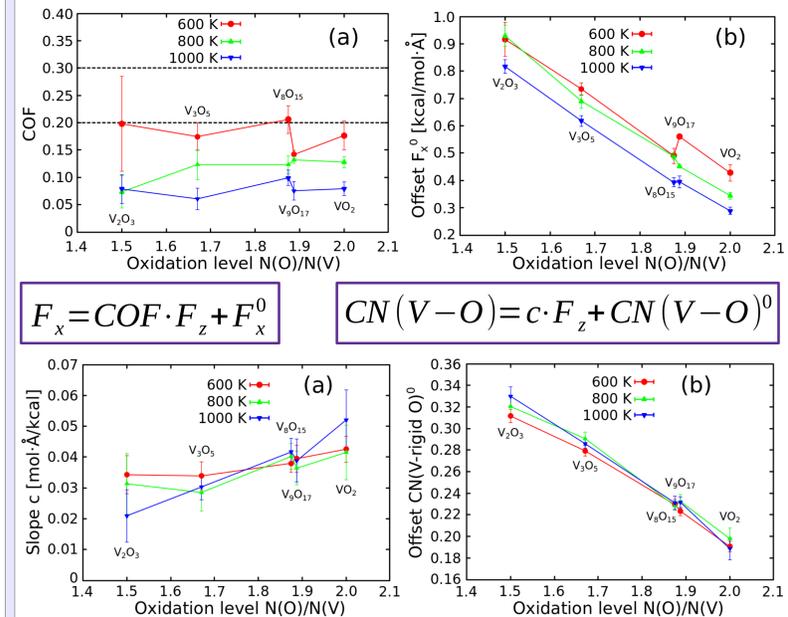
## Sliding simulations



## Sliding force $F_x$ and CN(V-O\*) vs. normal load $F_z$



## Slopes and offsets



## Conclusions

- Reactive molecular dynamics (reaxFF)** simulations of the tribological properties of five selected  $V_xO_y$  done. All **vanadium oxides** were **amorphous**, which is a favourable structural characteristic, since they can provide **liquid lubrication** with a considerably low friction coefficient (COF).
- Friction coefficient **COF** increases with temperature and it weakly depends on stoichiometry.
- Our study of  **$V_xO_y$  lubricants** provides a reliable reference which is relevant for the **development of hard and oxidation-resistant coatings** containing **vanadium** as a doping lubricious element.