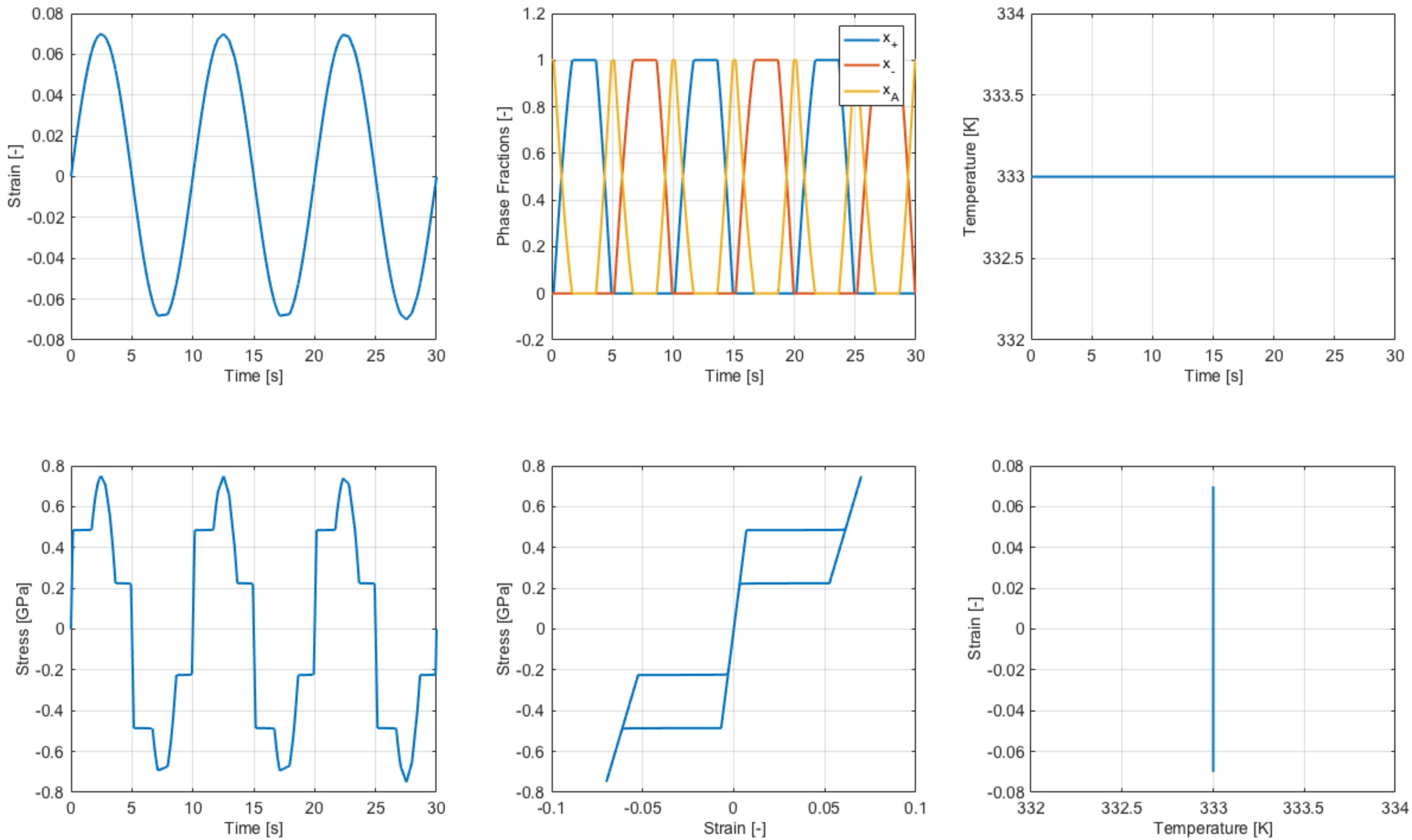
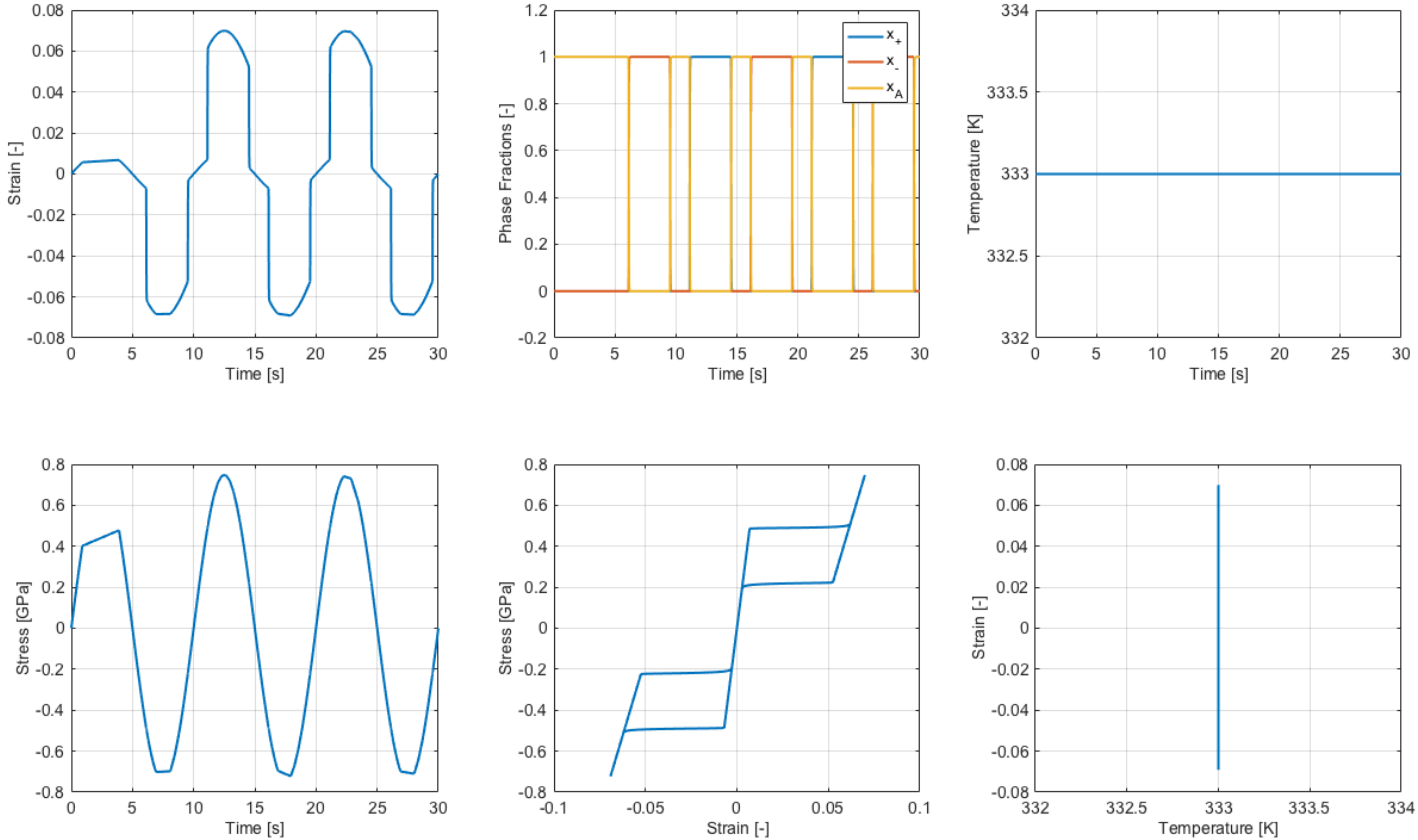
assignment02

Matthias Jost, 2551592
Tim Goll, 2554050

1a $\varepsilon(t) = 0.07sin(2\pi ft), f=0.1Hz$



1a $\sigma(t) = 0.75 \cdot 10^9 \sin(2\pi f t), f=0.1Hz$



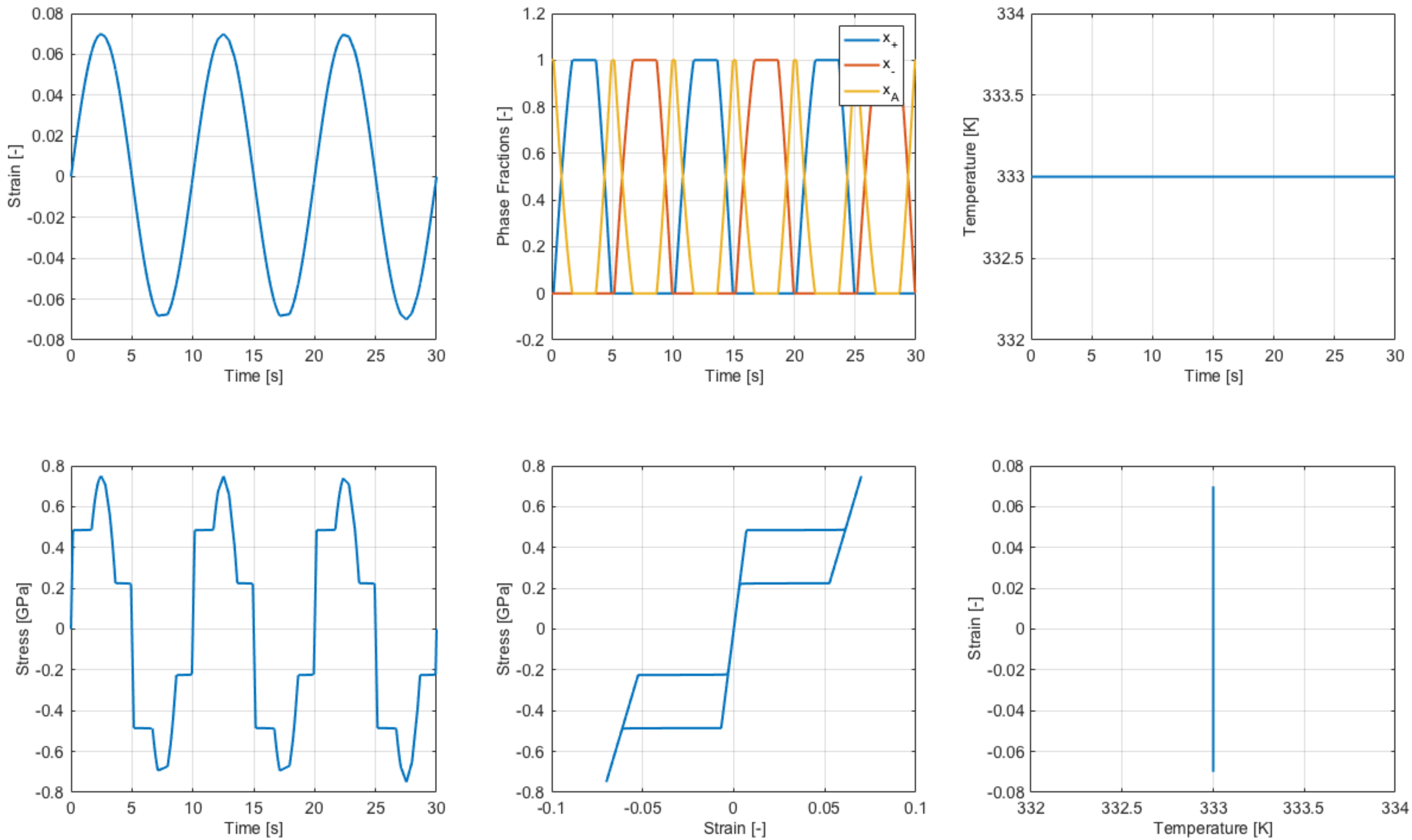
1a Interpreation

- Other than in all the other tasks, the focus in this one is on the "Phase fraction - Time" graph.

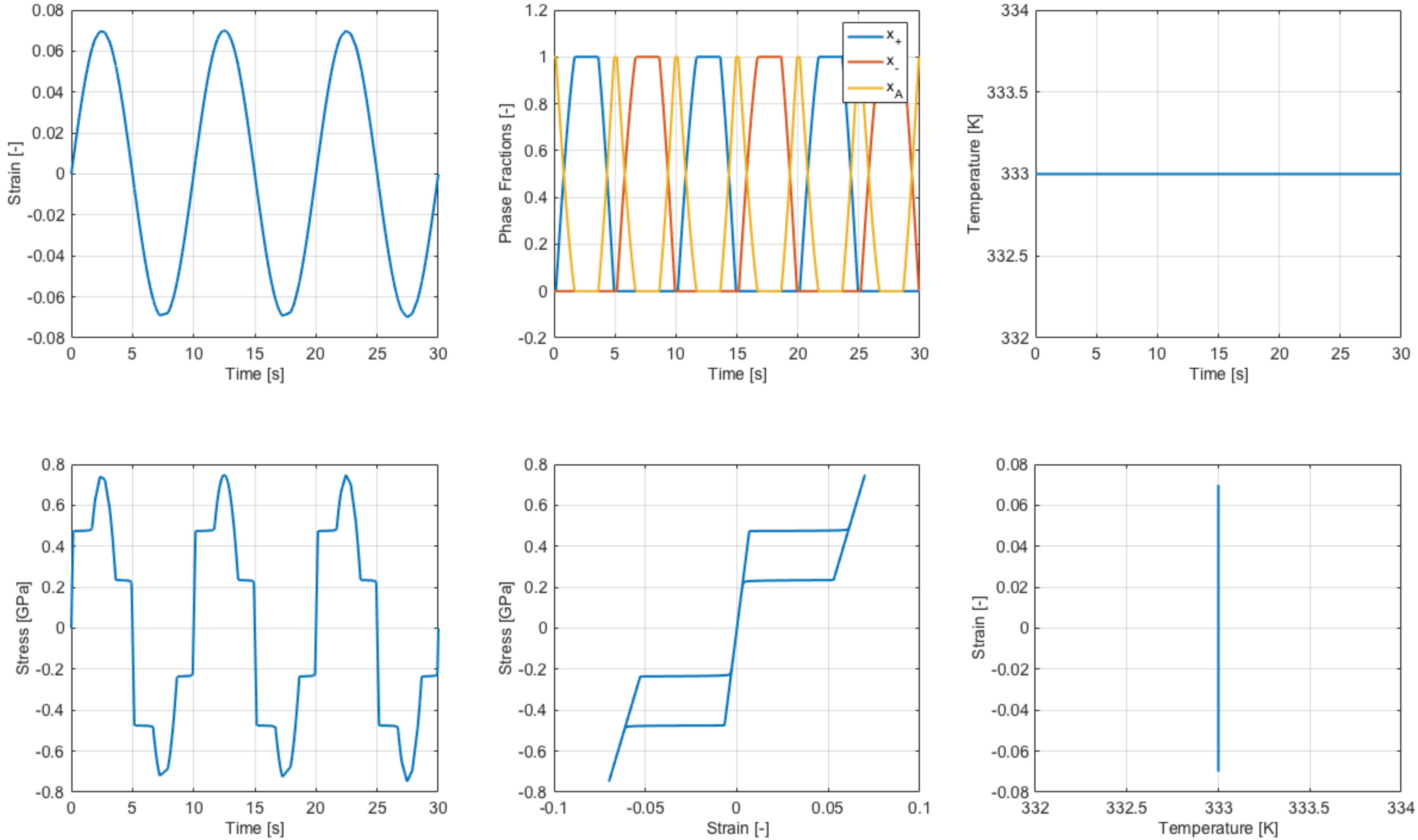
- *sin()*-strain (ε): the phase fraction has constant values and slopes between them.
  This is because the phase transformation starts after reaching a minimum value of stress. This specific value is created through the strain which creates plateau values in the stress graph. Therefore the stress is limited by the needed stress to switch one grid element from austenite to Martensite (M+ and M-) and vice versa

- *sin()*-stress (σ): There are hard jumps between the contant values.
  This is caused by the minimum stress needed to switch from one phase to another. In case of reaching this specific value all atoms are switches simultaneously.
  [see colorcoding in the top line: A, M- A, M+, A, ...]

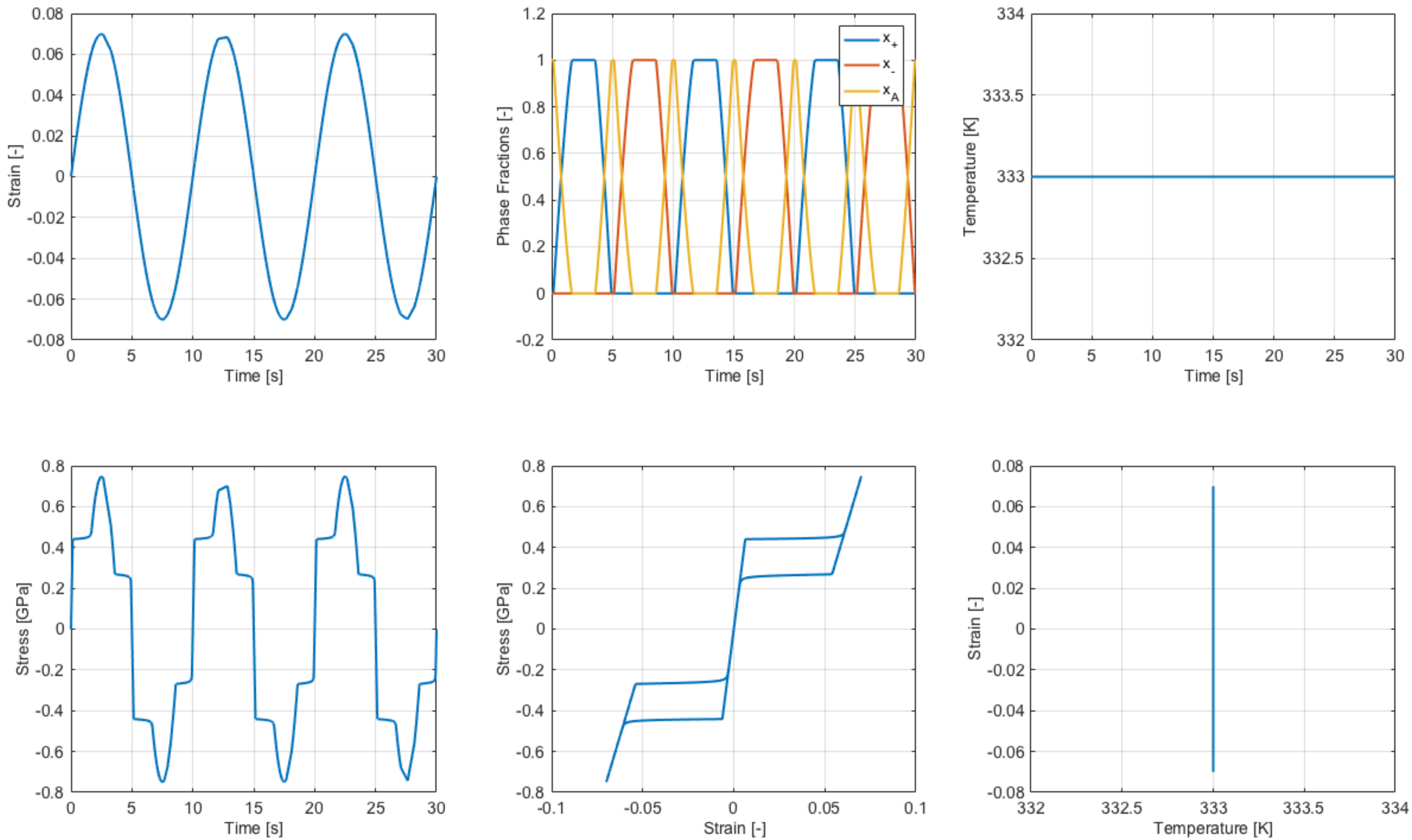
1b Activation volume: 10^{-23}



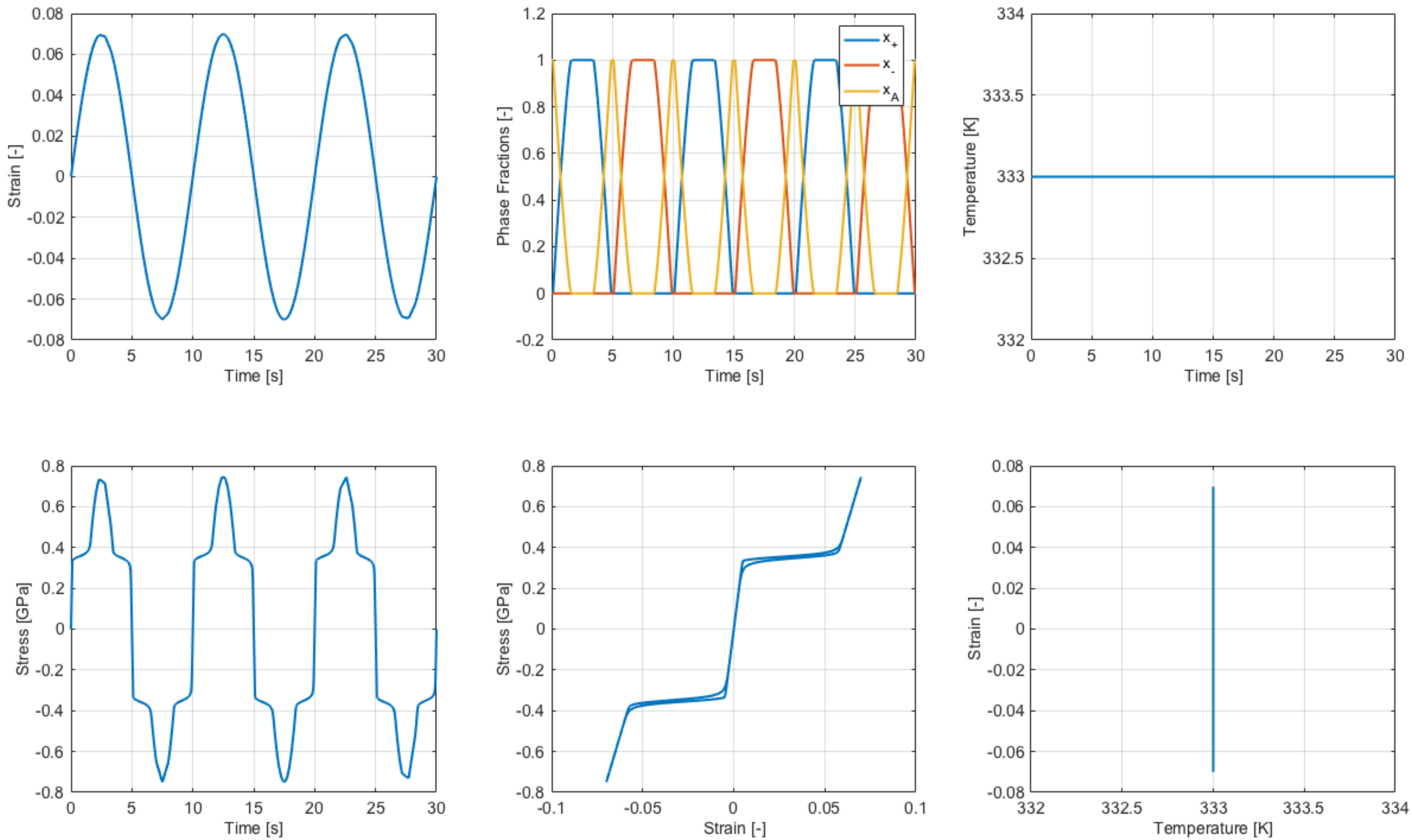
1b Activation volume: 10^{-24}



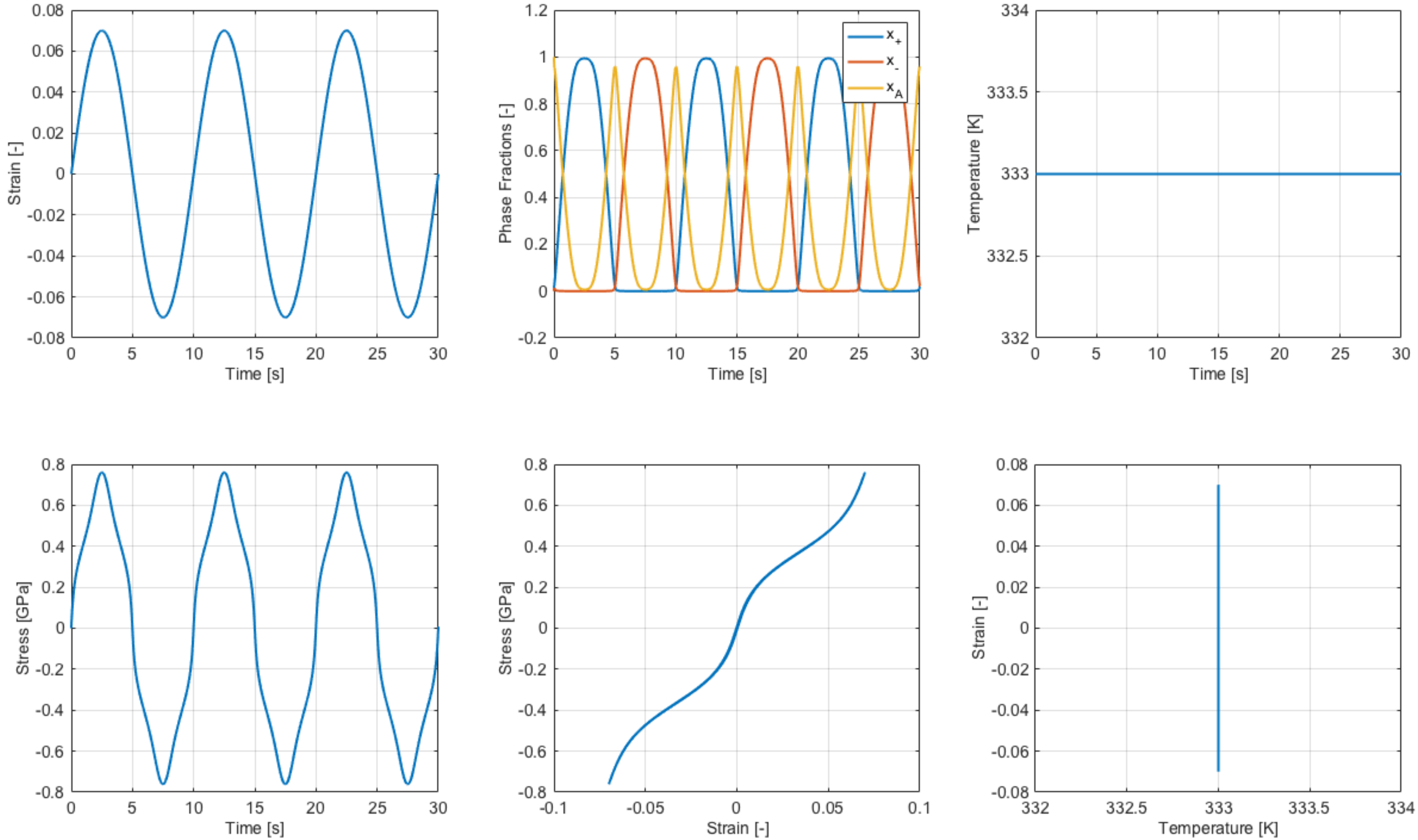
1b Activation volume: 10^{-25}



1b Activation volume: 10^{-26}



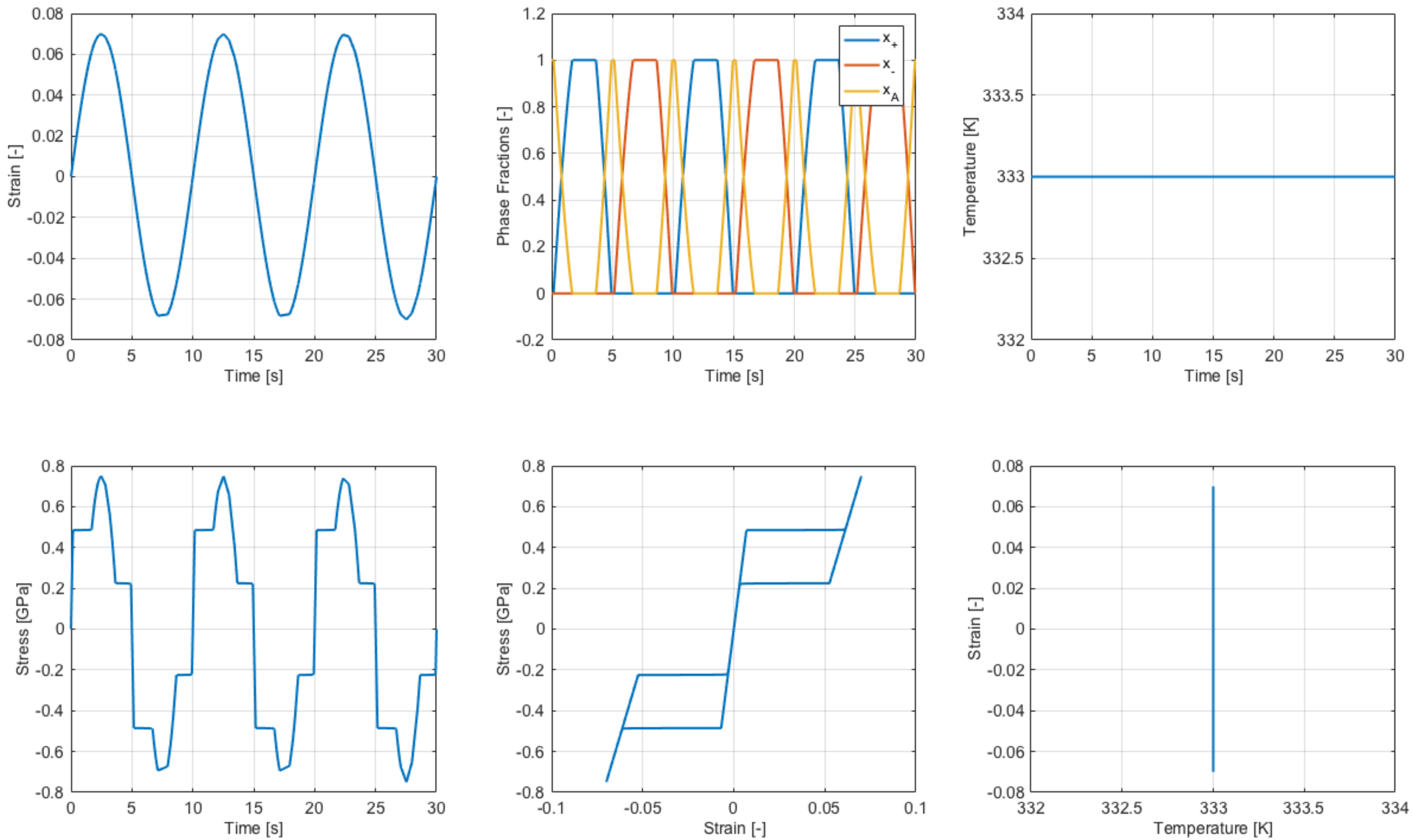
1b Activation volume: 10^{-27}



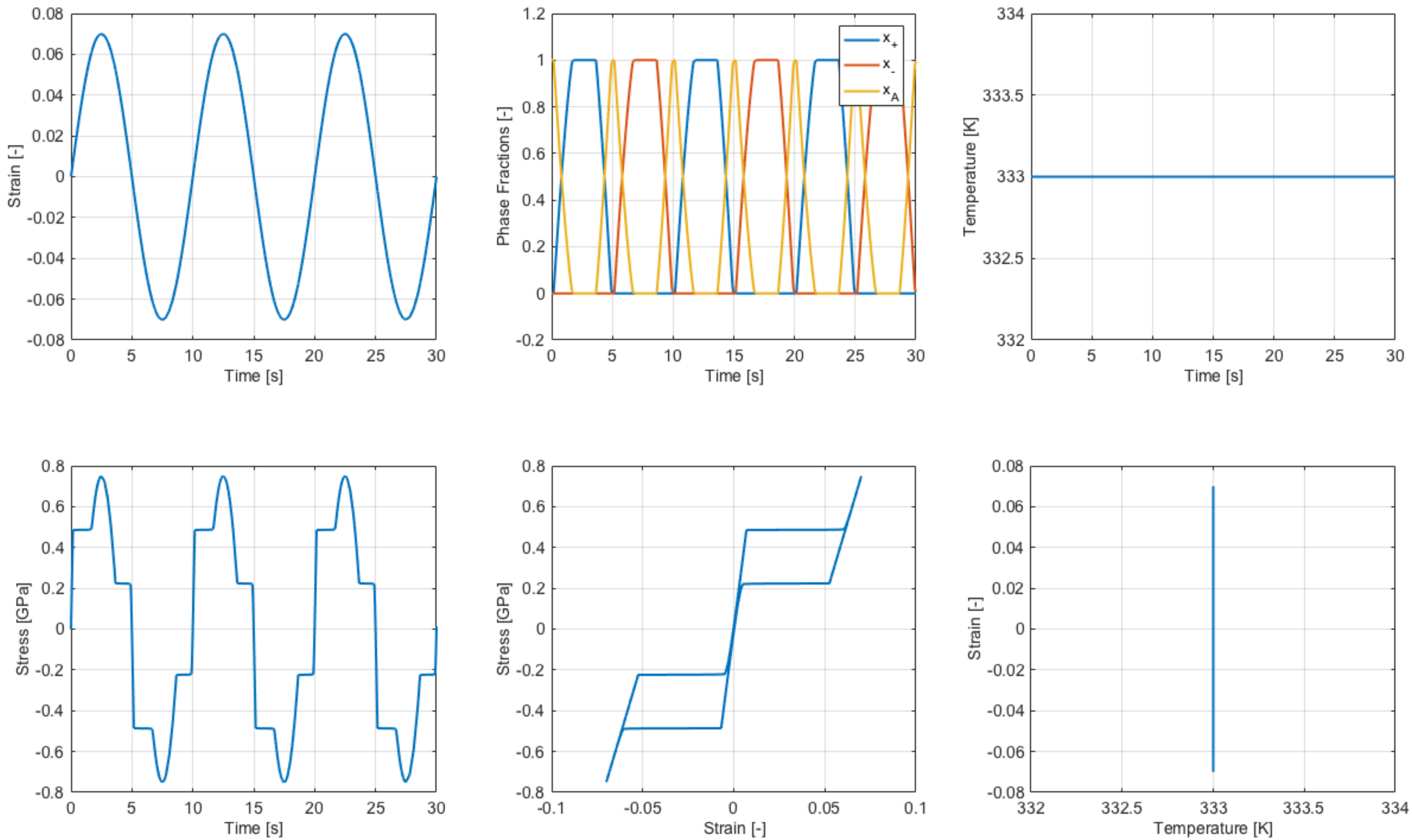
1b Interpretation

- The less atoms are available per layer (smaller volume), the smaller the hysteresis gets. This is because the switching behaviour of a small grid is nearly perfectly defined and the hyseresis is caused by multiple atoms.

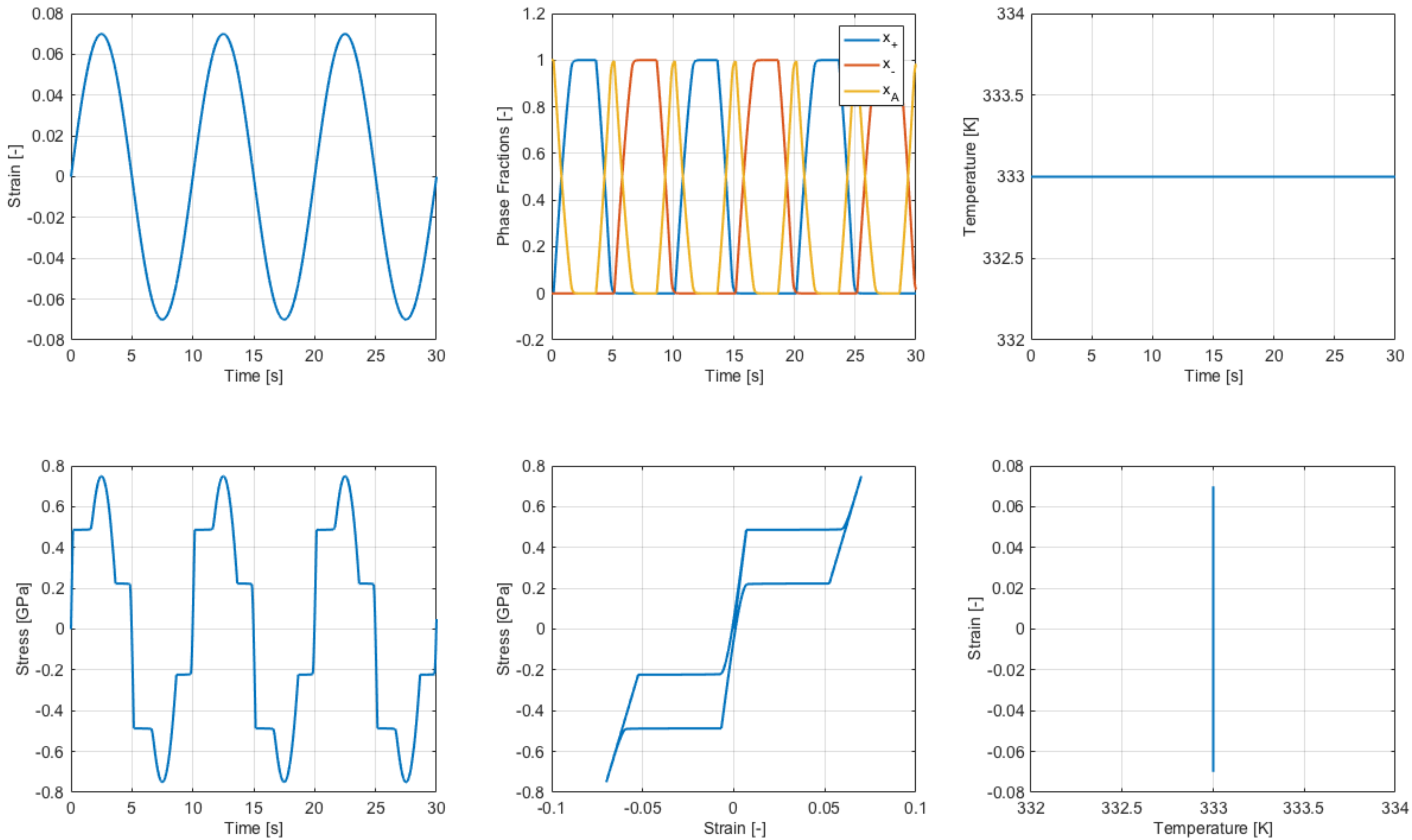
1c Vibration frequency: $0.01Hz$



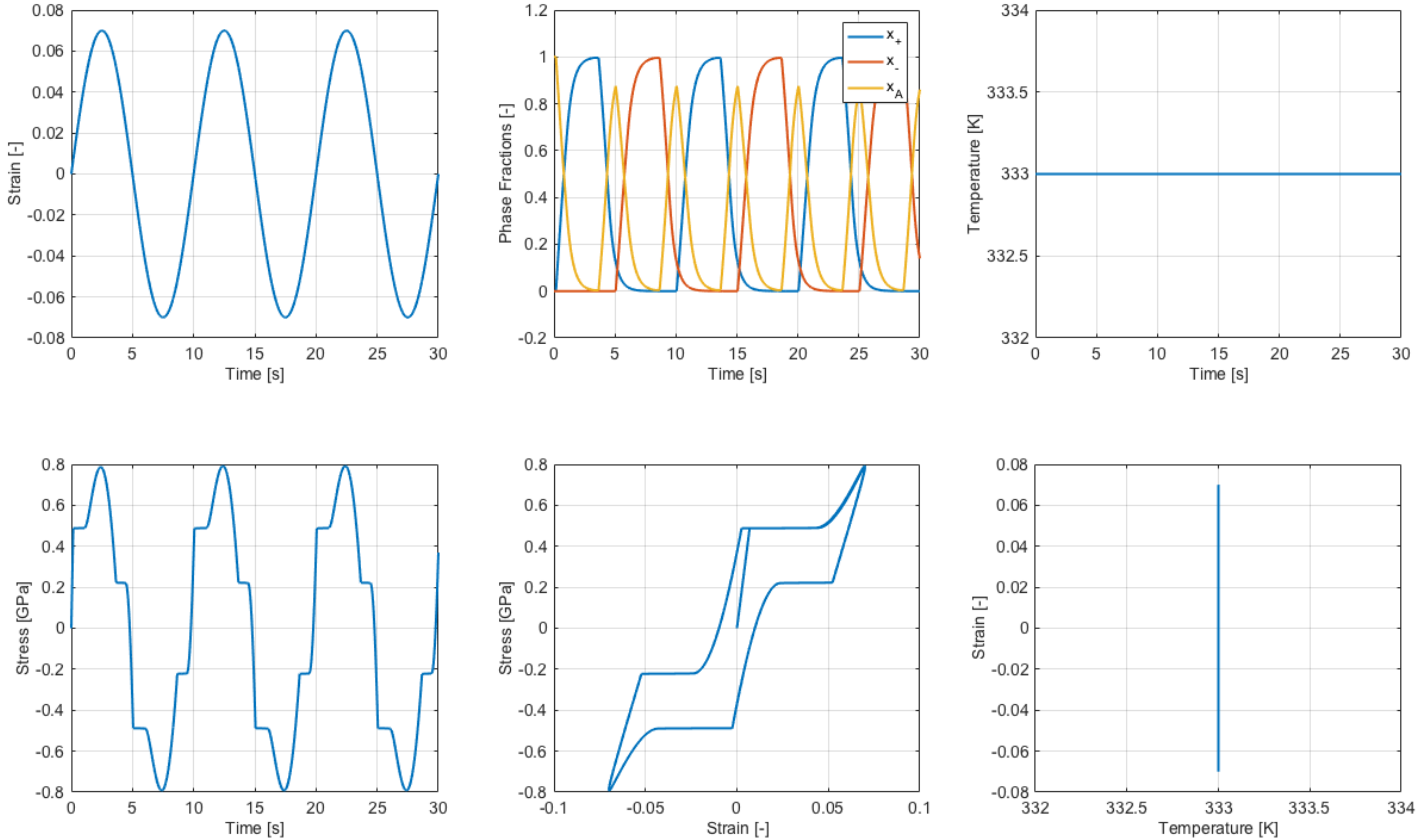
1c Vibration frequency: $0.05Hz$



1c Vibration frequency: $0.1Hz$



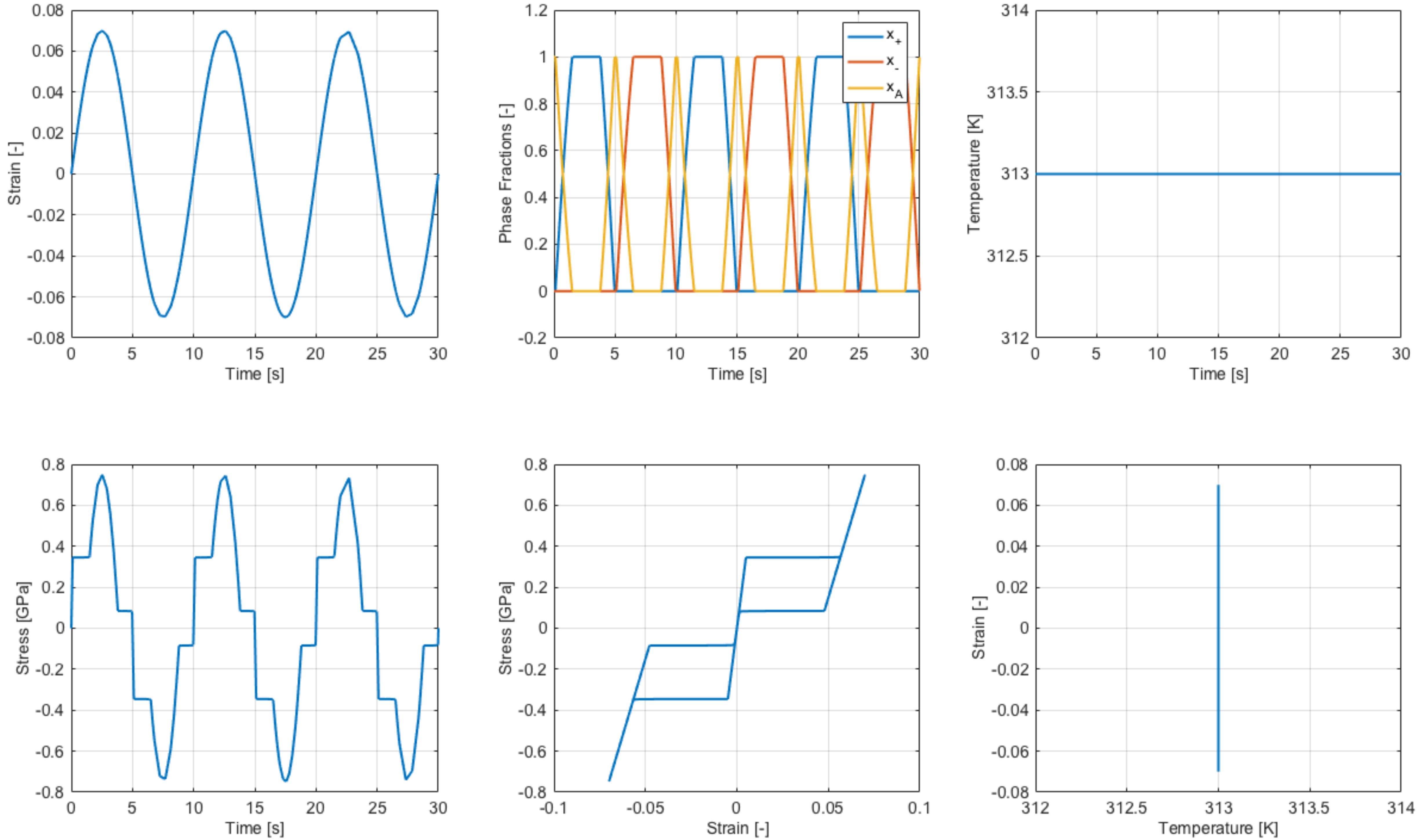
1c Vibration frequency: $0.5Hz$



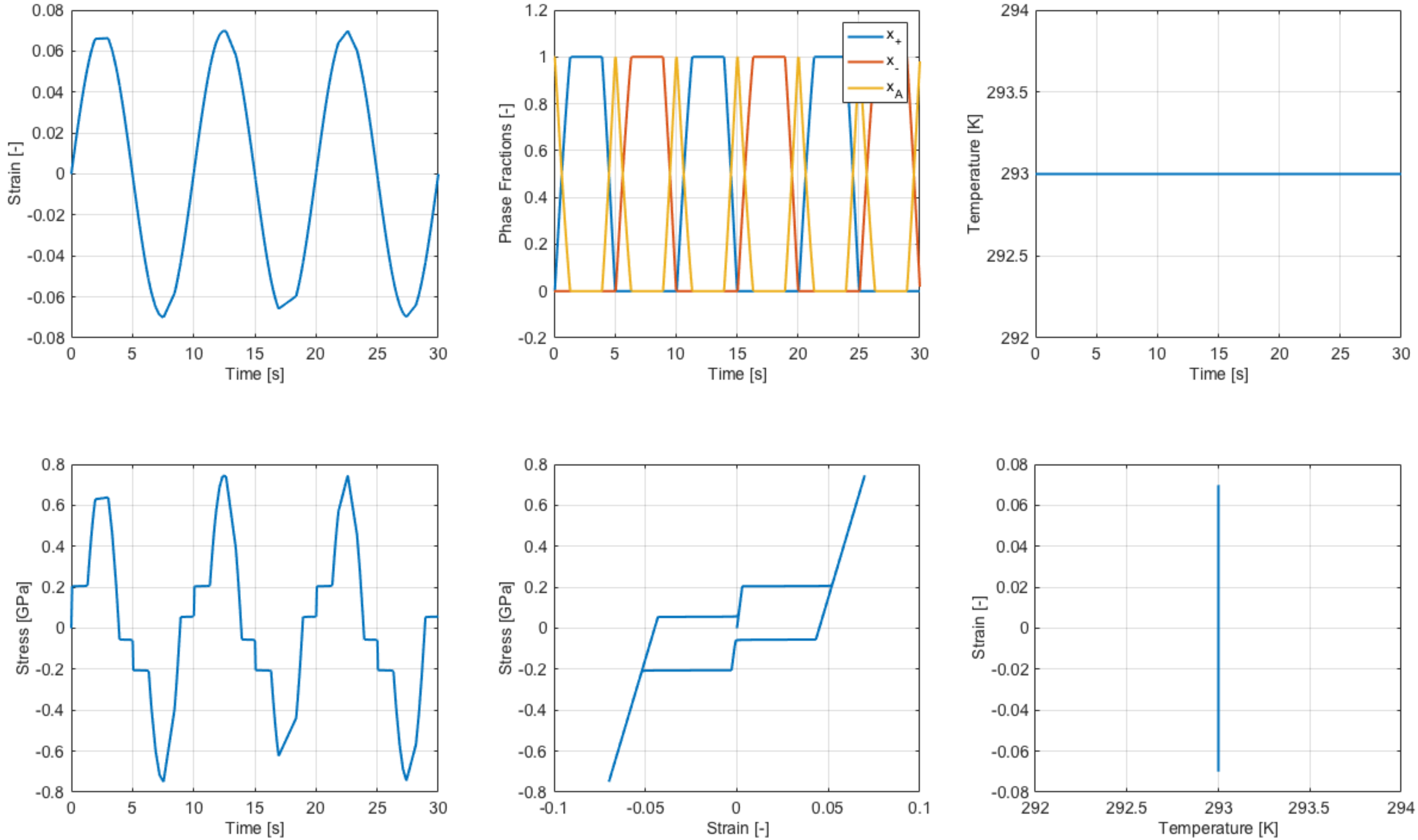
1c Interpretation

- The hysteresis looks this off with a faster frequency because the stronger vibration means that the grid can switch its state faster

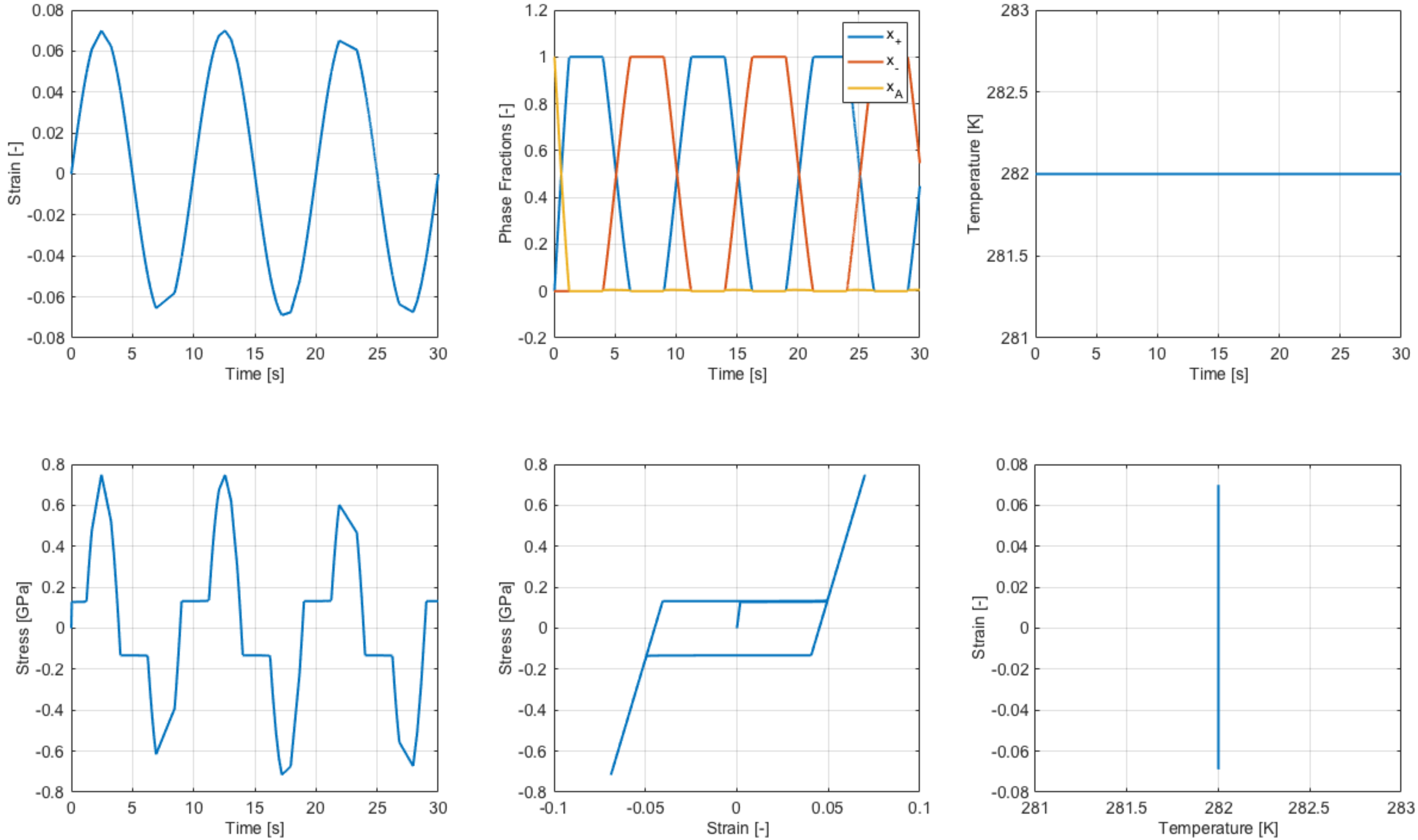
2 Temperature: *313K*



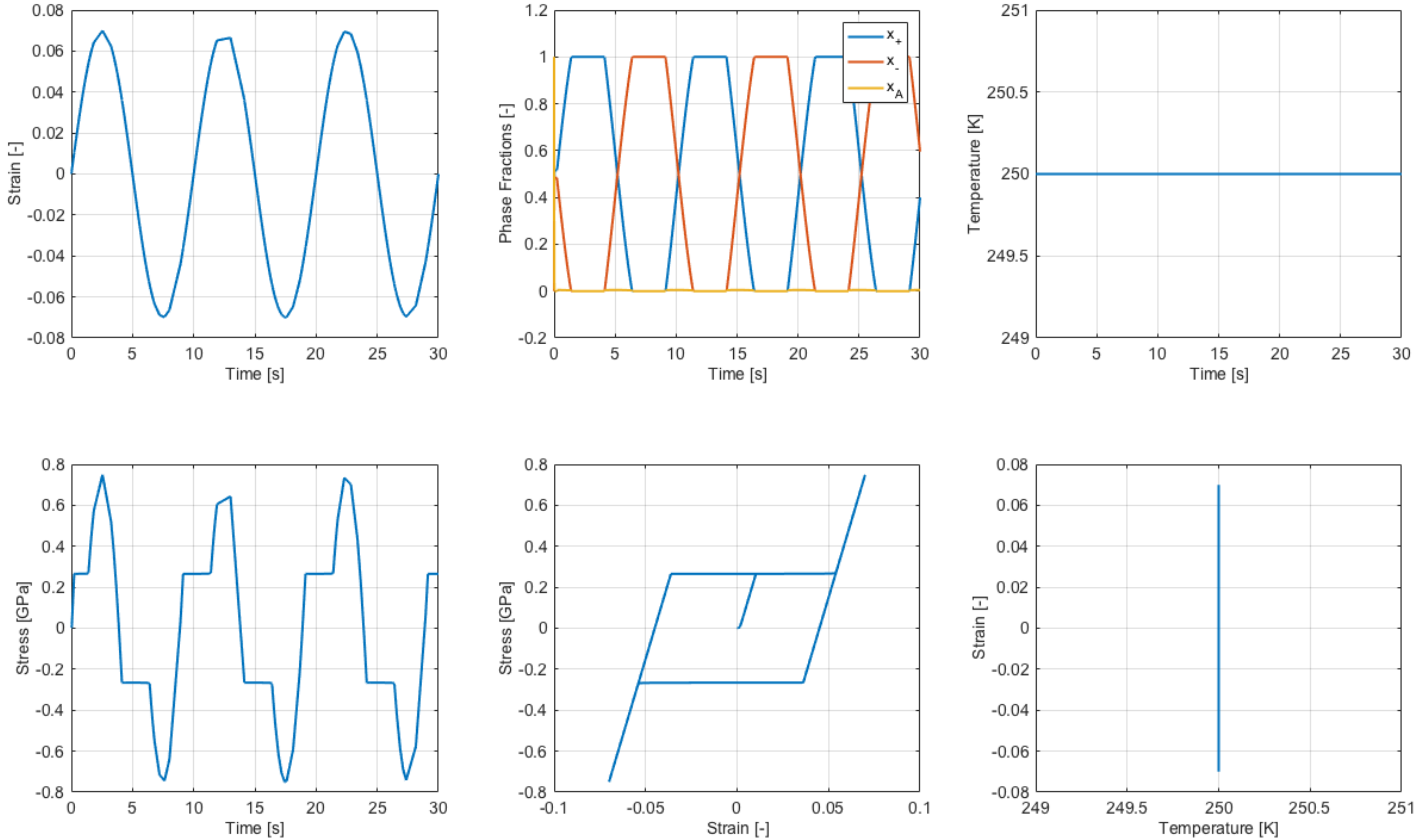
2 Temperature: $293K$



2 Temperature: $282K$



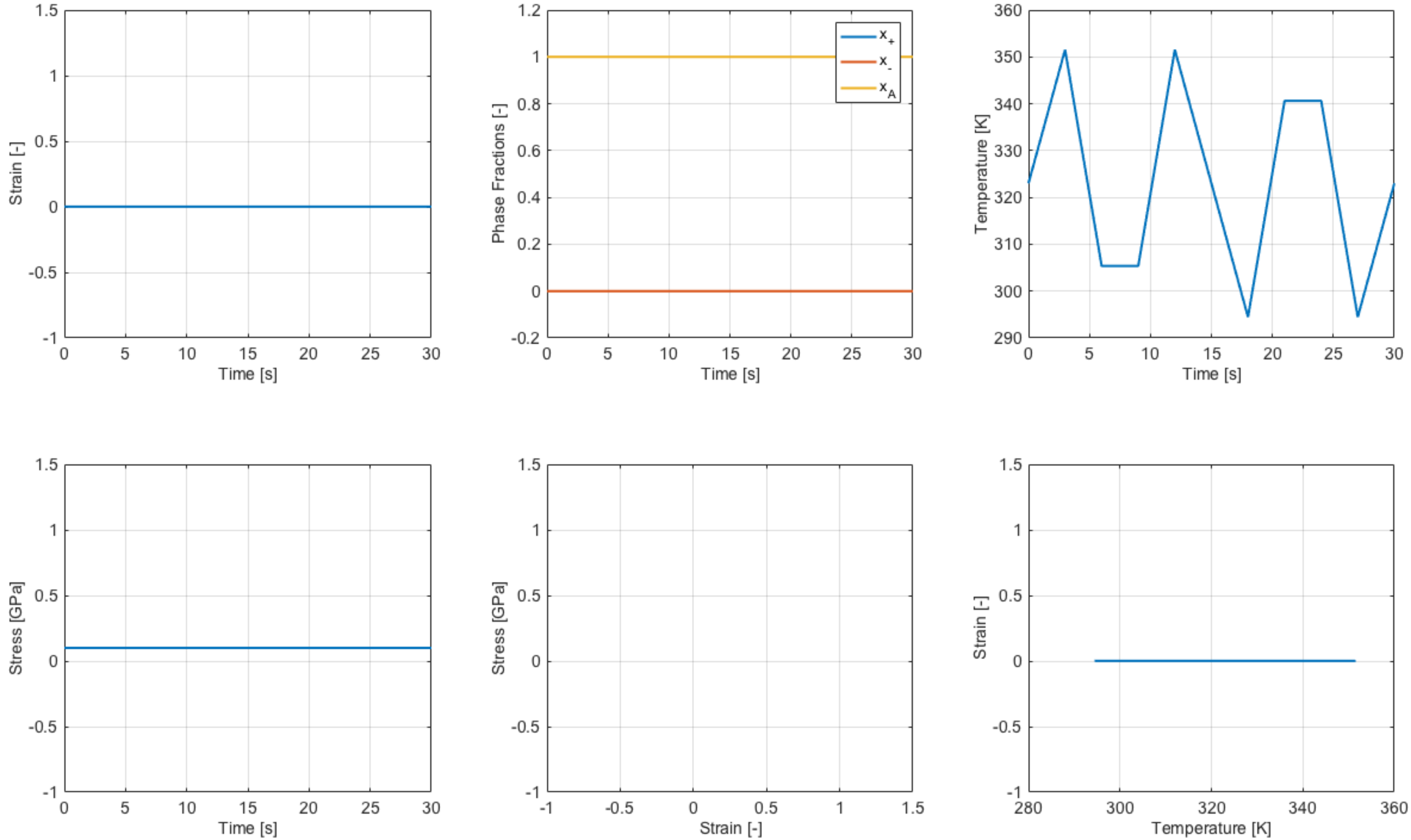
2 Temperature: $250K$



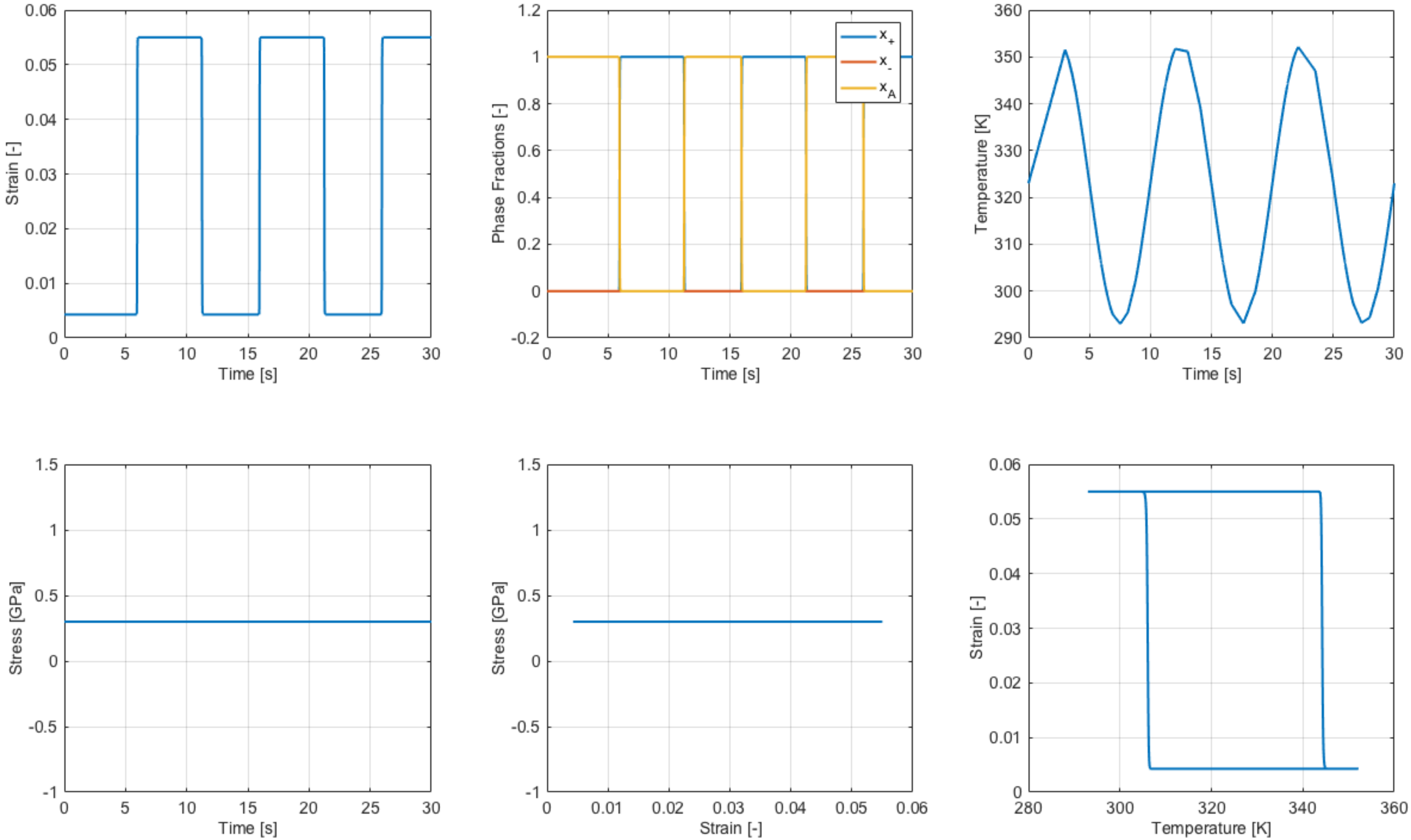
2 Interpretation

- The warmer the SMA wire is the more diverse the hysteresis is.
  This is because the austenite phase must be possible to 'fill' the part around the origin. If the SMA is too cold it is unable to reach the austenite phase and therefore the praph splits into two seperate hysteresis graphs

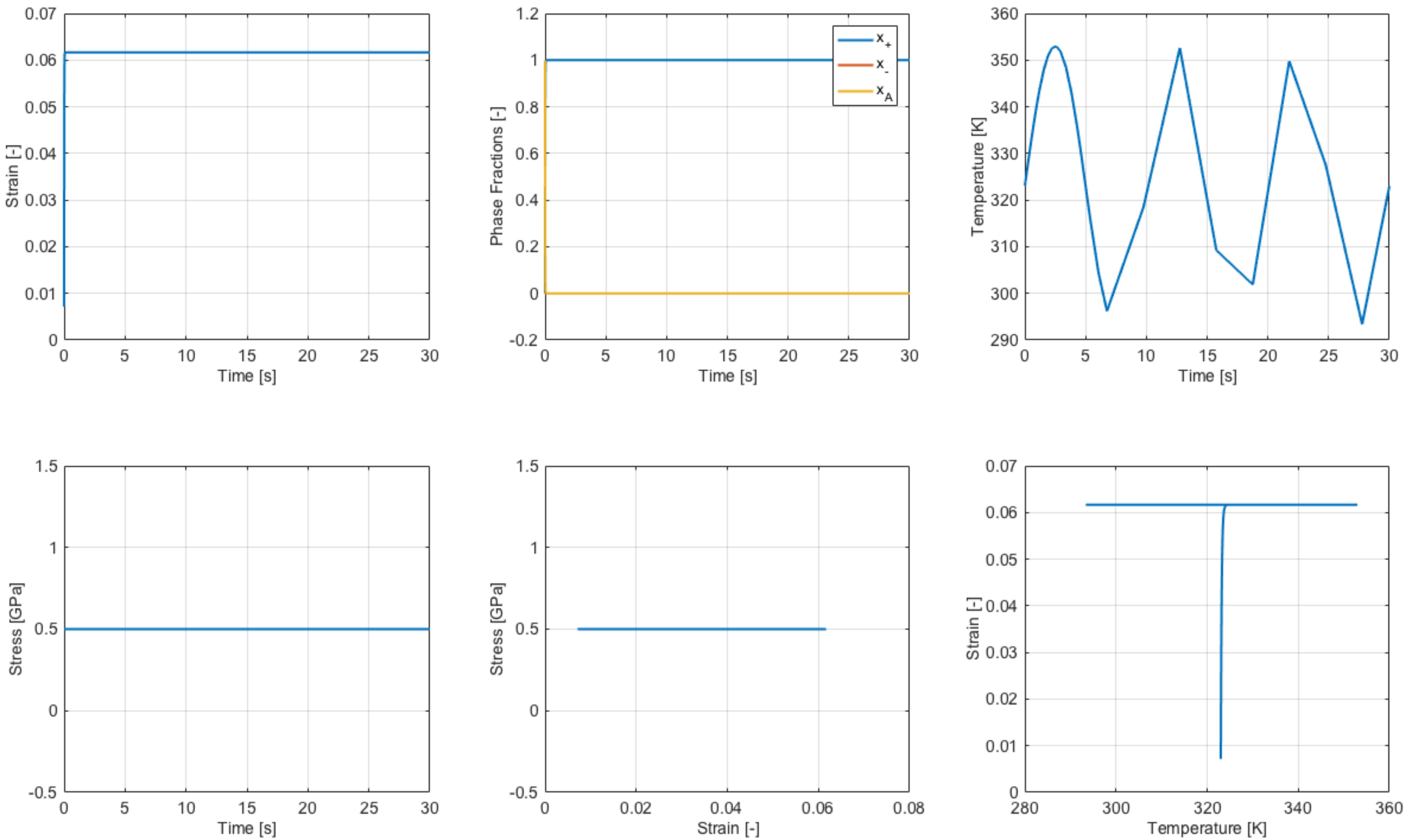
3 Stress: *$0.1*10^9$ Pa*



3 Stress: $0.3*10^9$ *Pa*



3 Stress: $0.5*10^9$ Pa



3 Interpretation

- 1: stress is too low to enter the stress-strain-hysteresis, therefore the strain isn’t changed by the temperature (mixed Martensit+ and Martensit-)
- 2: stress is within the hysteris, which is the working area of a SMA (changing between Martensit+ and Martensit-)
- 3: it is like case 1. But the SMA starts in its default condition and has to jump in the new state (Martensit+)