Supporting information

TDS Baking - In the baking process, only a quartz boat is heated in the TDS chamber for 3 h at 900 °C. Figure S1 shows the baking TDS data for the 1st cycle. Because the temperature is too high, so the absorbed gases are released from the boat in the 1st cycle. Presence of absorbed gases after 1st cycle is confirmed by performing 2nd cycle of baking process as shown in figure S2. In the 2nd baking cycle, TDS data does not show any considerable peak. Which indicate that all the absorbed gases by the quartz boat released in the 1st cycle. Later during all the TDS experiments, the boat is used only within the Ar atmosphere without any environmental contact. So after the baking process; There is no absorption of environmental gases by the quartz boat.

TDS test experiment - In the next step, TDS blank test experiment has been performed for all the base samples without Na_2O. So that the gases absorbed only by the base sample and quartz boat do not affect the experiment. for instance, Figure S3 shows 1st cycle of blank test data for the Ti alloy base sample. It shows no specific peak that there is no environmental gases absorption by the Ti alloy base sample. During all subsequent TDS experiments, all base samples with quartz boats are used only in Ar environment without any environmental interaction.

In the last step of the TDS experiment, all the base samples have been tested with Na_2O.

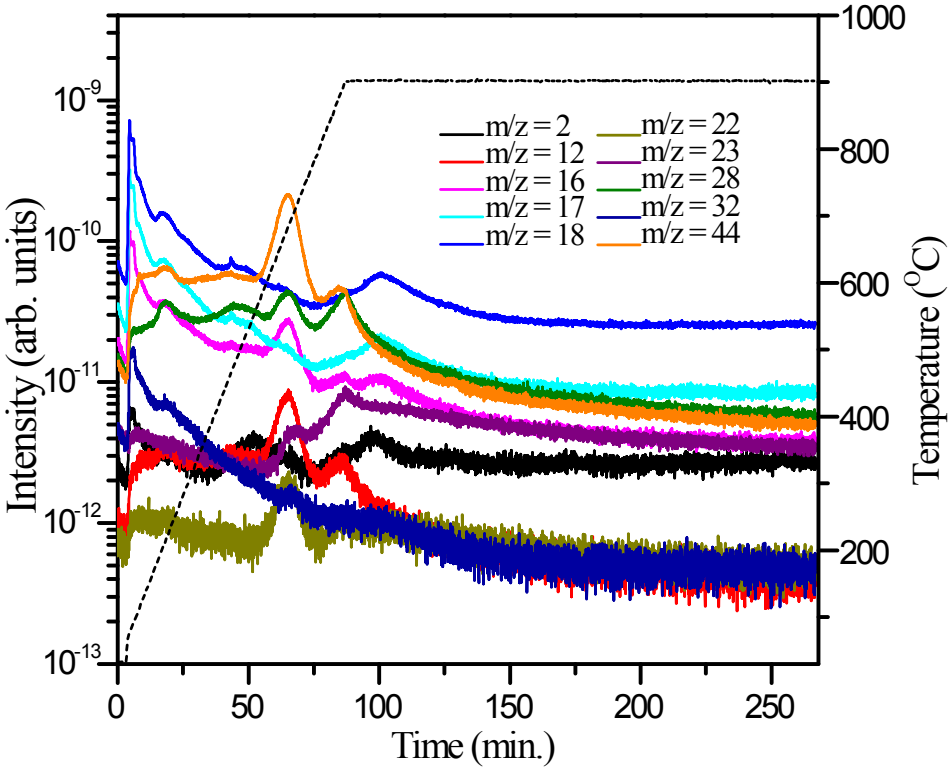

Figure S1: TDS data for the 1st cycle of baking process.

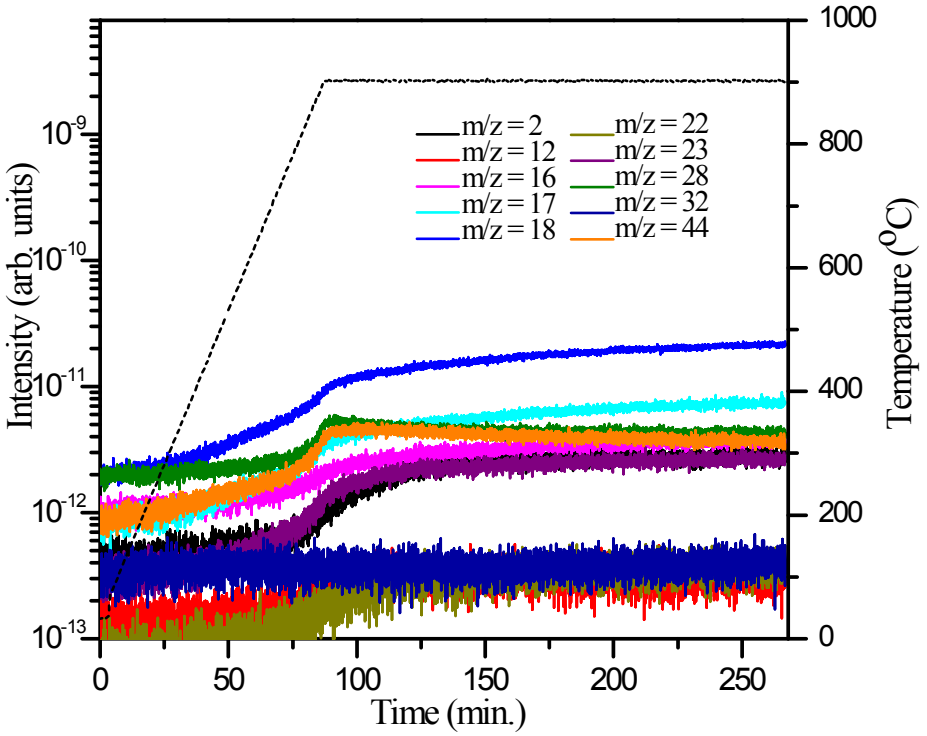

Figure S2: TDS data for the 2nd cycle of baking process.

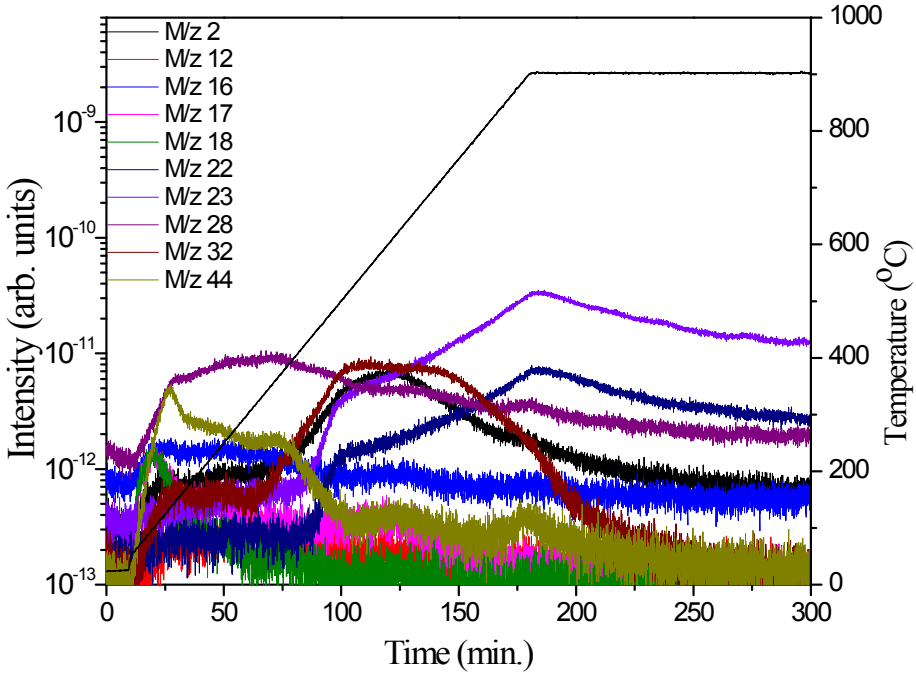

Figure S3: TDS data for the 1st cycle of blank test experiment.

Targeted and calibrated temperature - The targeted temperature is the goal temperature of the heating part of the TDS system as shown in figure S5. The calibrated temperature is the temperature recorded over the surface of the base sample, where Na_2O sample is kept during the TDS experiment. The schematic representation of the TDS chamber configuration for the temperature measurement is shown in figure S5. From the obtained blank test data for Ti-alloy, the targeted and calibrated temperature data also plotted as shown in the figure S4.

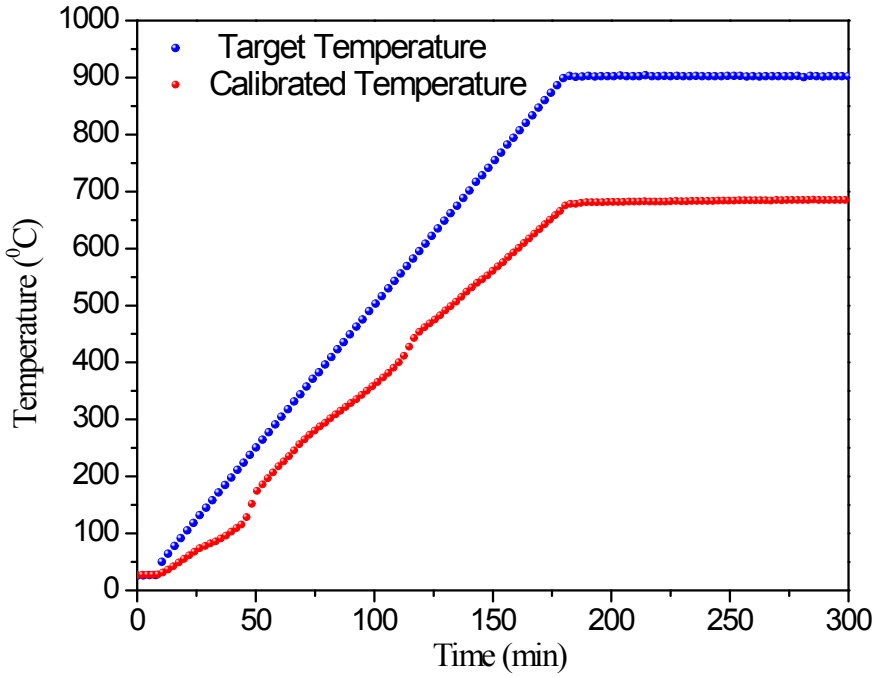

Figure S4: Temperature calibration graph for targeted and calibrated temperature.

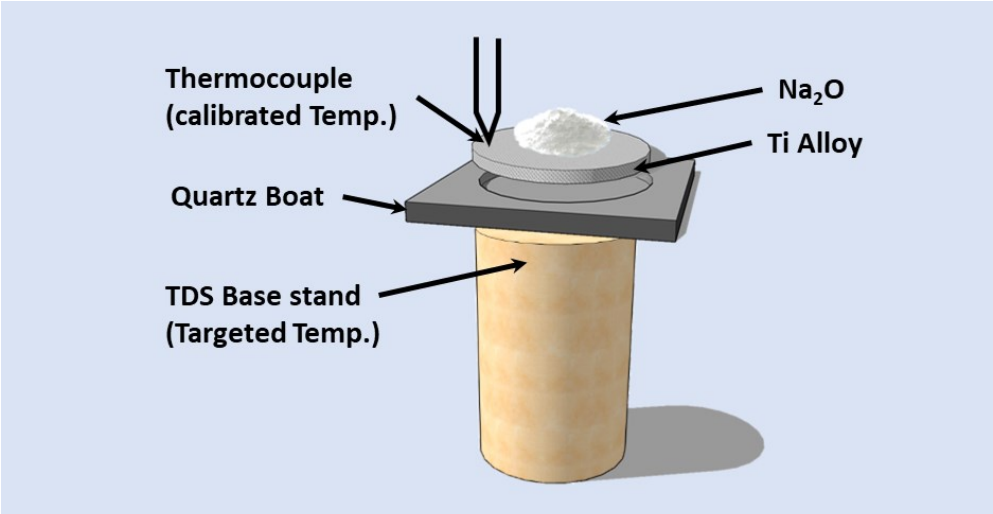

Figure S5: TDS chamber Configuration for the experiment.

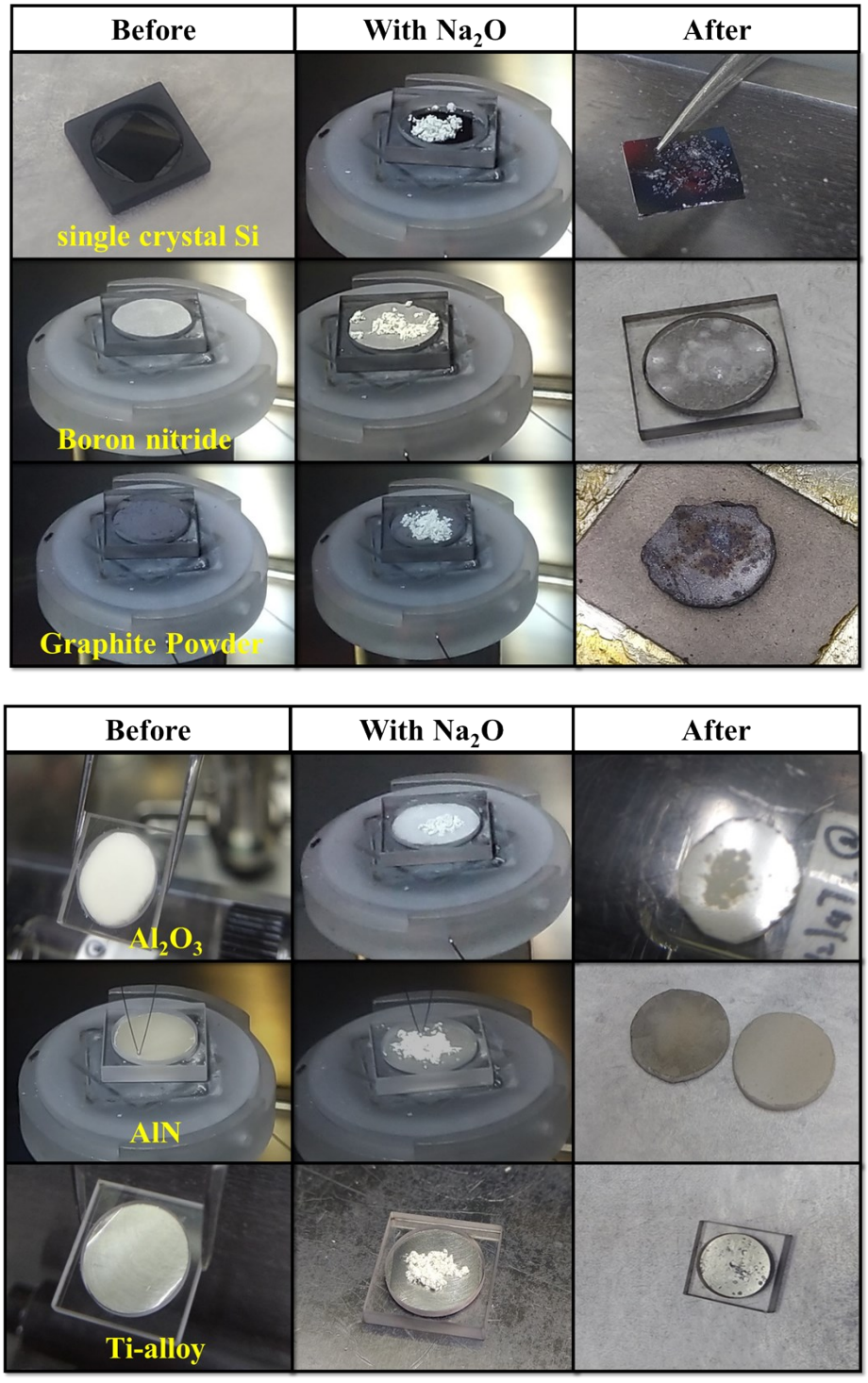

Figure S6: photographs of various samples at different stages during the corrosion resistance observation.

Ti alloy

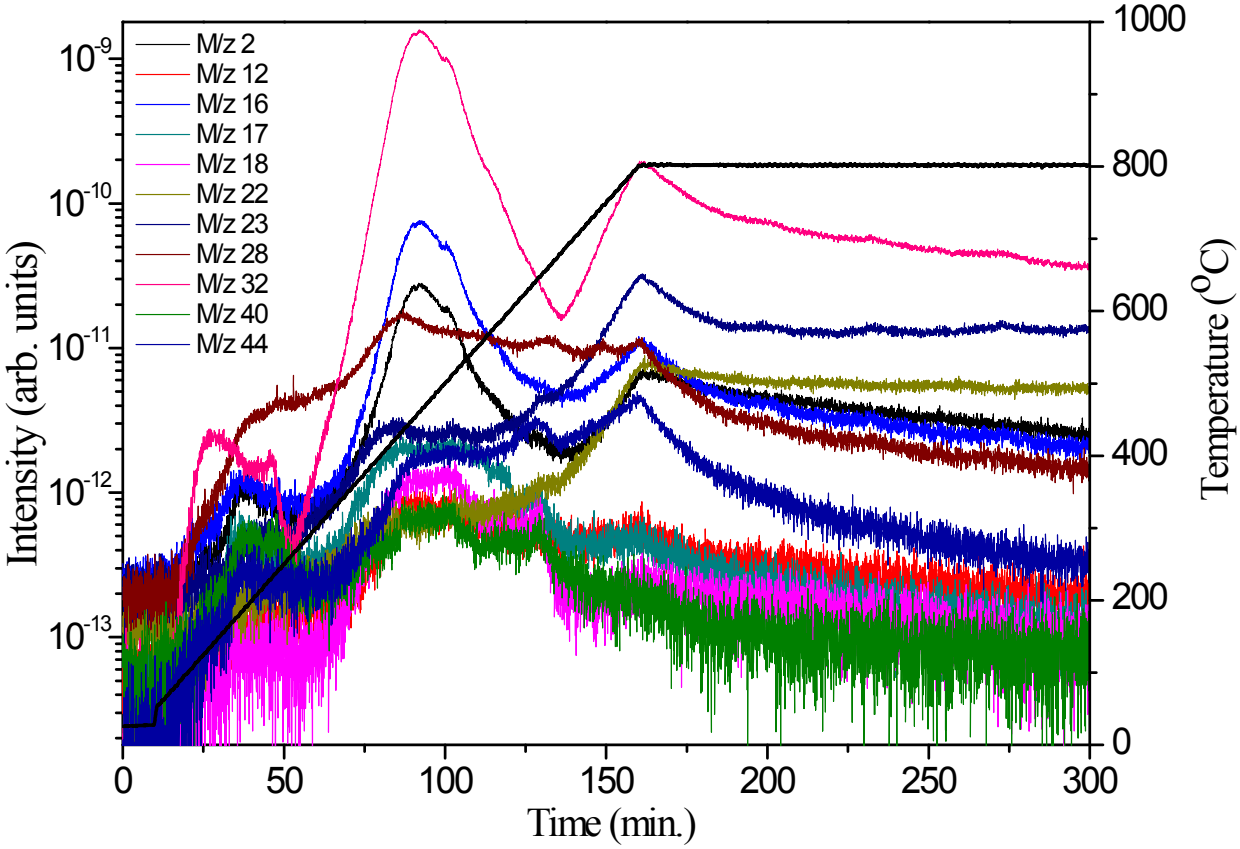

Figure S7: TDS spectra of Na_2O with the Ti alloy base perform at 800 °C.

Boron Nitride (BN)

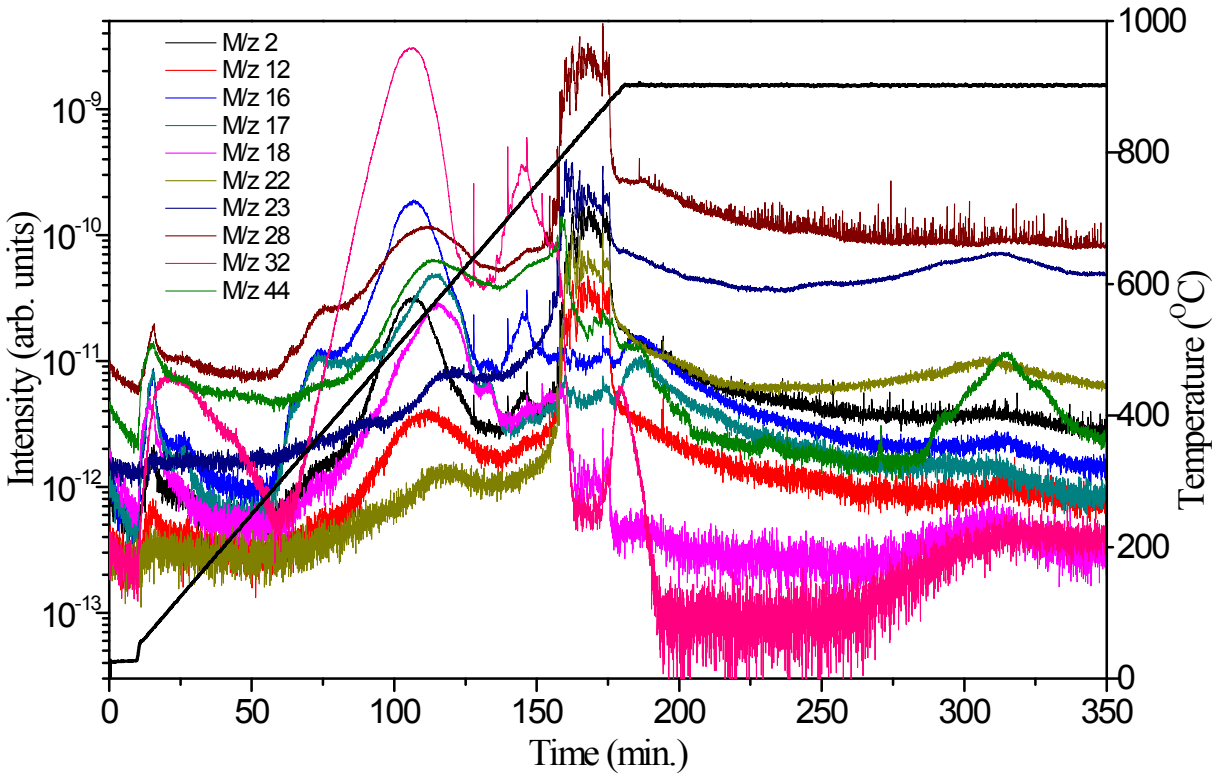

Figure S8: TDS spectra of Na_2O with the Boron Nitride (BN) base perform at 900 °C.

Single crystal Si

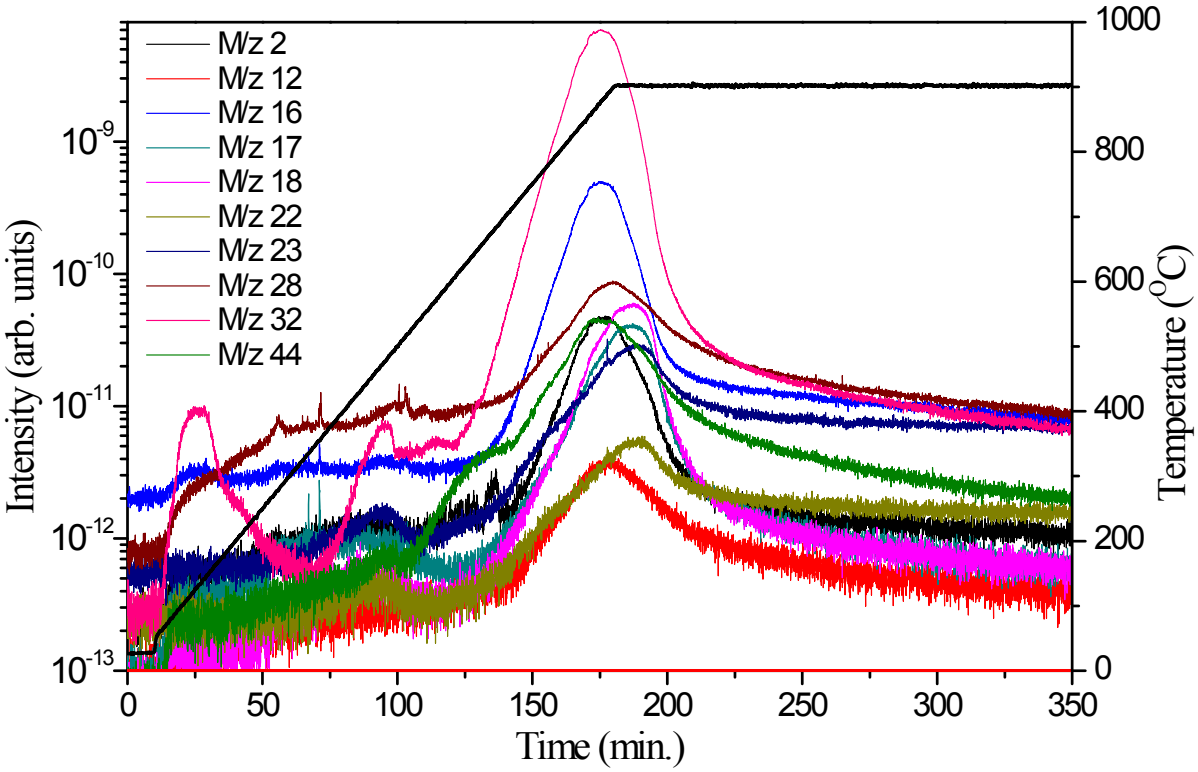

Figure S9: TDS spectra of Na_2O with the Single crystal Si base perform at 900 °C.

Polished Graphite

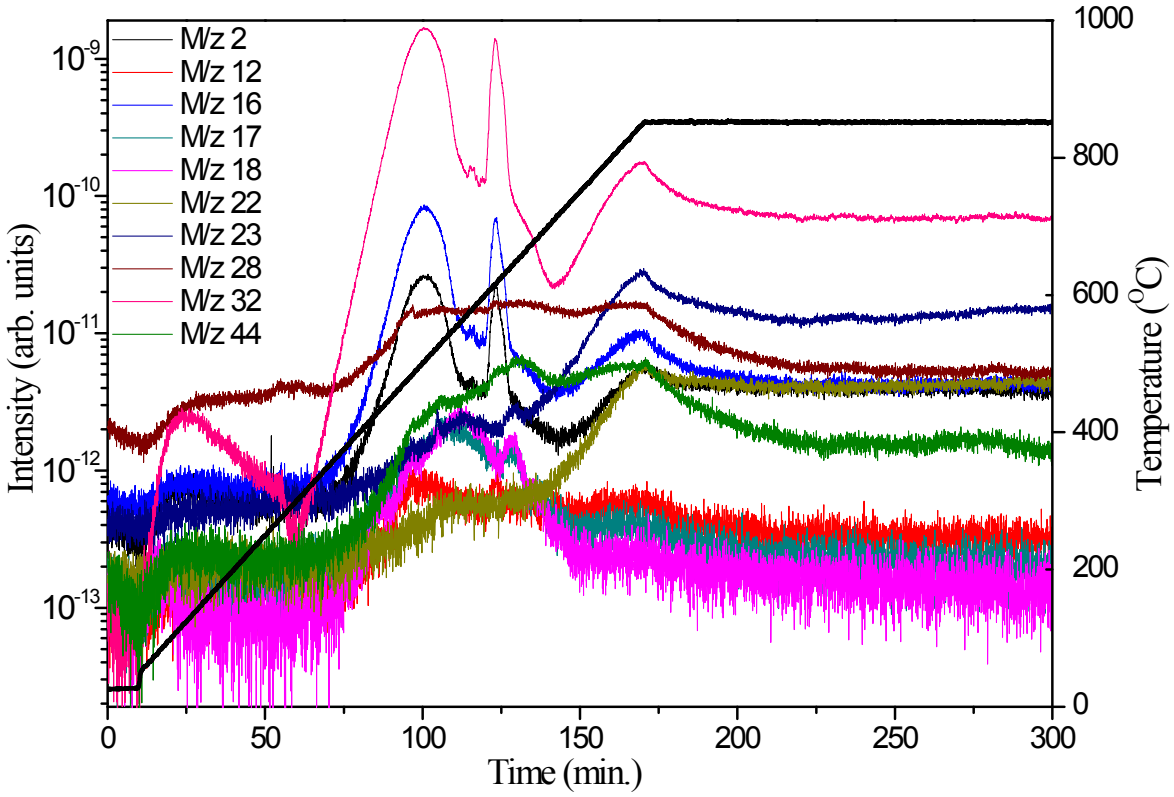

Figure S10: TDS spectra of Na_2O with the Polished Graphite base perform at 850 °C.

Aluminium oxide (Al_2O_3)

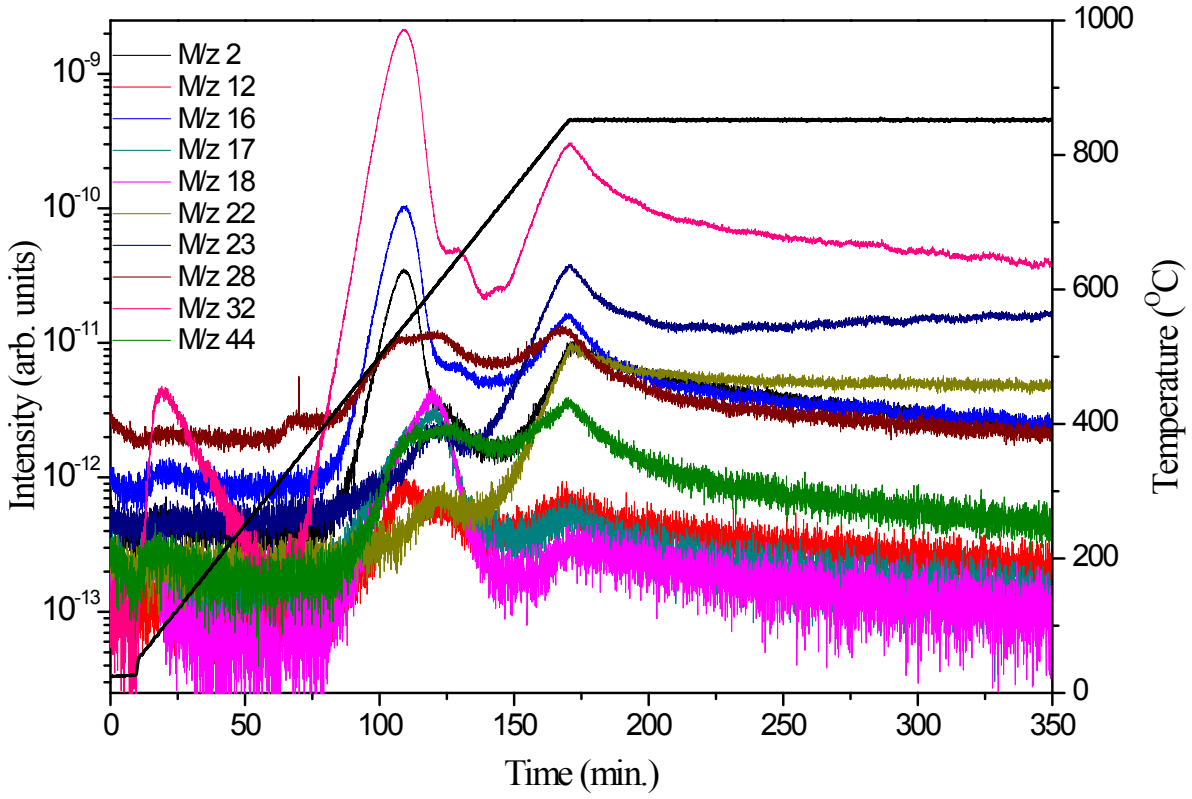

Figure S11: TDS spectra of Na_2O with the Aluminium oxide (Al_2O_3) base perform at 850°C.

Thermodynamic calculation by MALT software

Na_2O react with C and generates Na and sodium carbonate and further decompose in Na, CO_2, and O_2.

$$3Na_2O + C \rightarrow Na_2CO_3 + 4Na \ (< 450^{O}C)$$

$$3Na_2O + C \rightarrow 6Na + CO_2 + ½\ O_2 \ (> 450^{O}C)$$

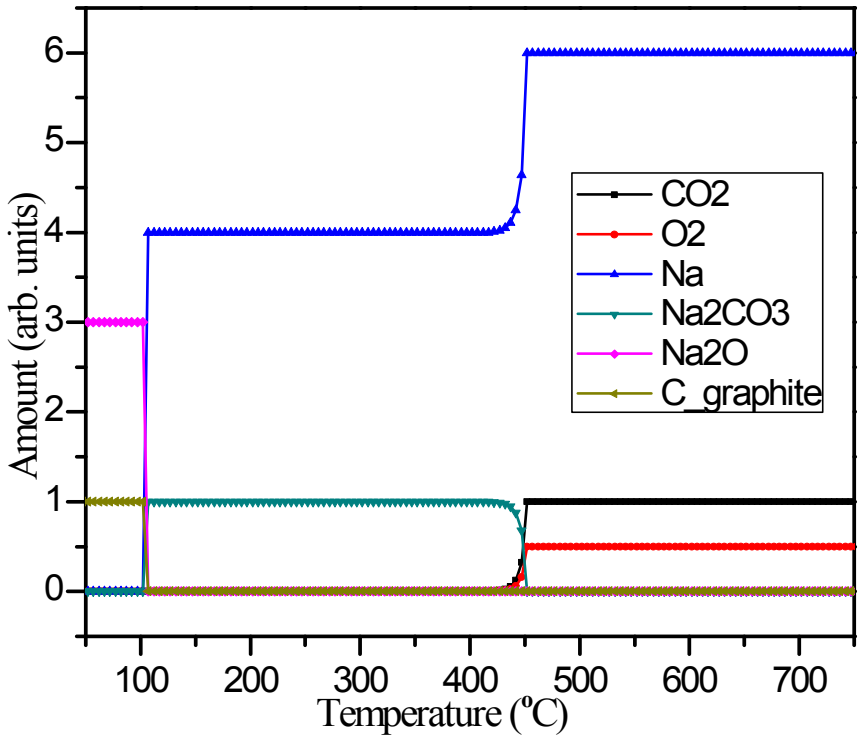

Figure S12: MALT software calculation for Na_2O and graphite reaction with temperature.

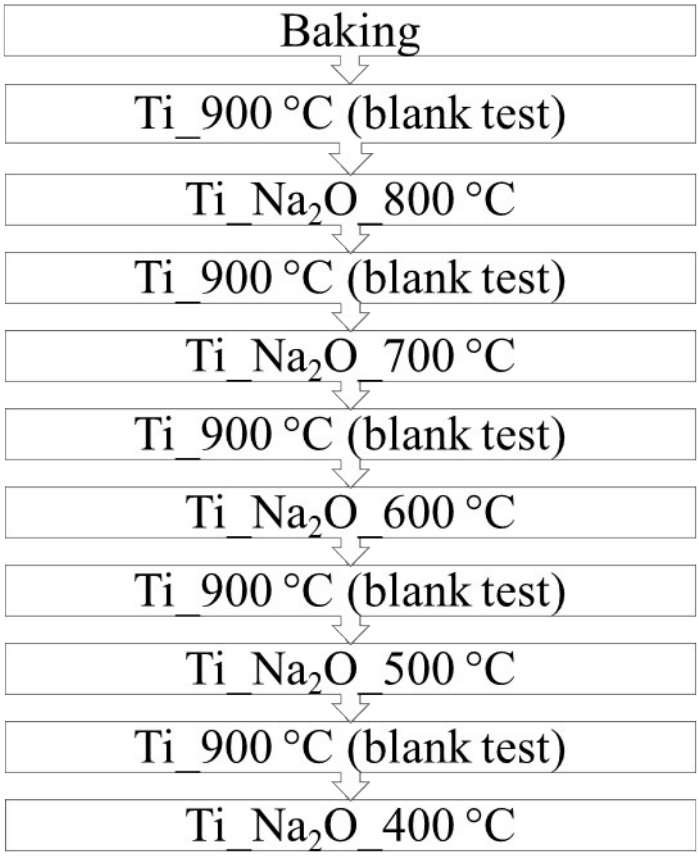

Figure S13: Schematic process of TDS experiment for Ti alloy optimization.

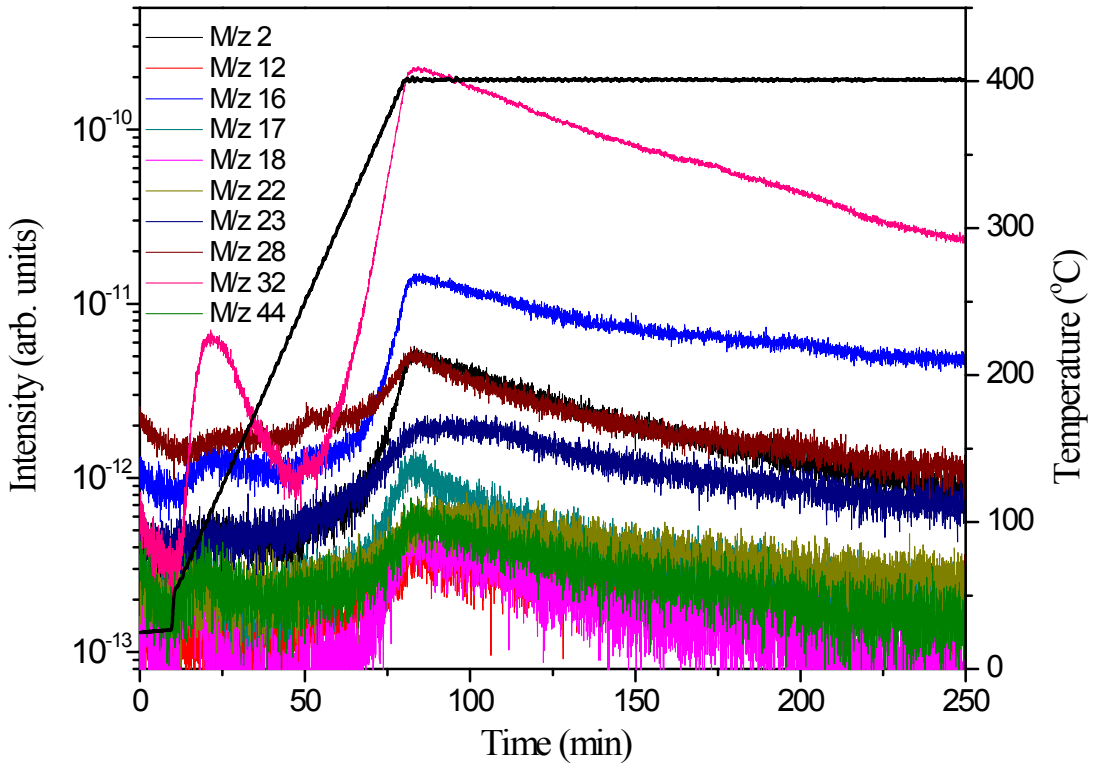

Figure S14: TDS spectra of Na_2O with the Ti alloy base perform at 400°C