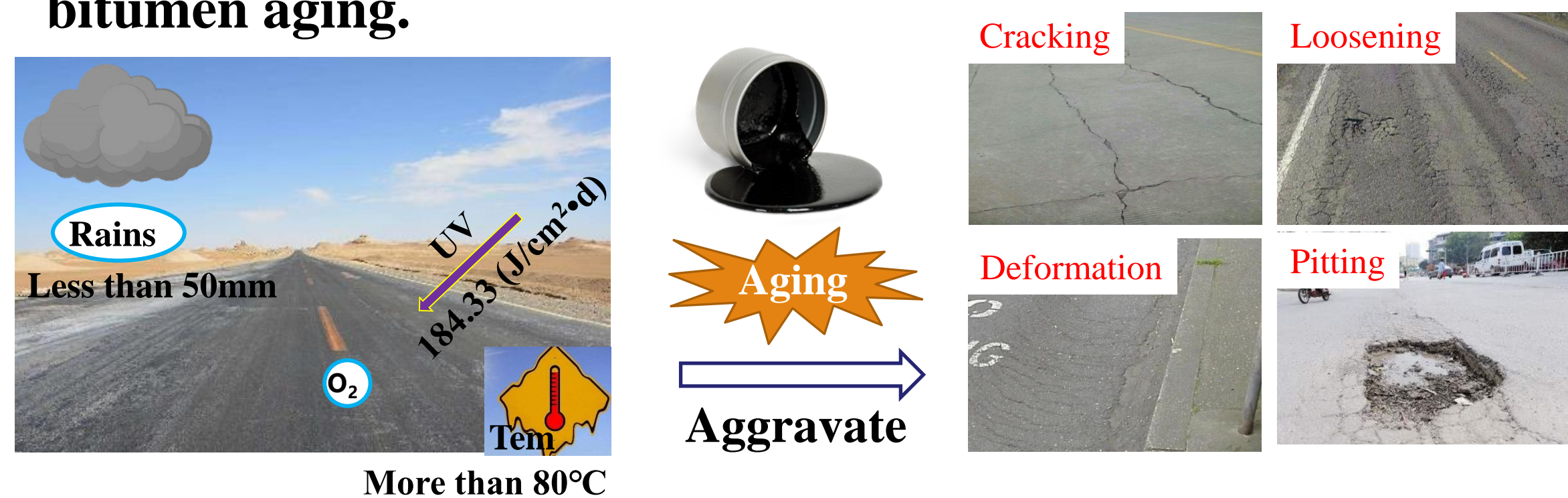




INTRODUCTION

- The extreme environments have led to the serious aging of road materials in cold-arid region.
- There are differences between laboratory simulated aging and natural aging.
- Different environmental factors show different effects on bitumen aging.

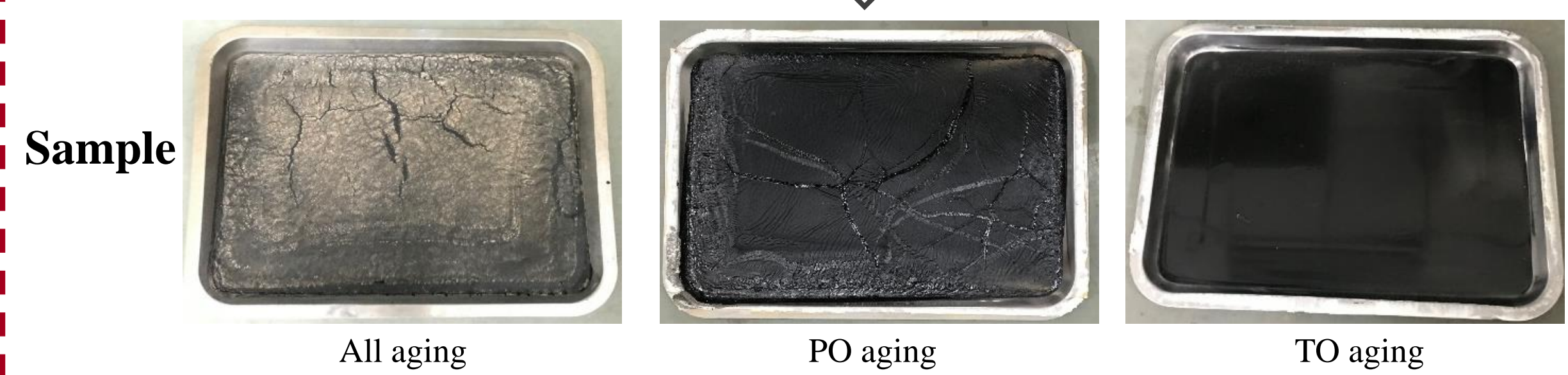
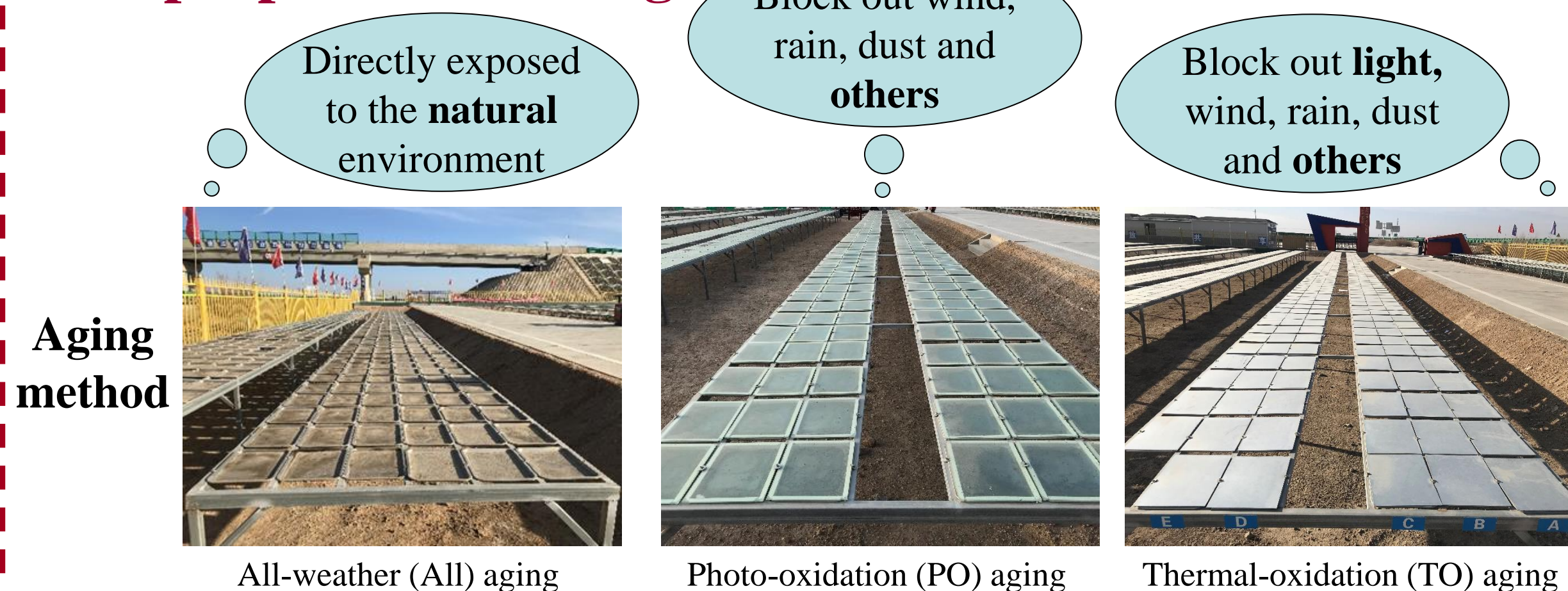


OBJECTIVES

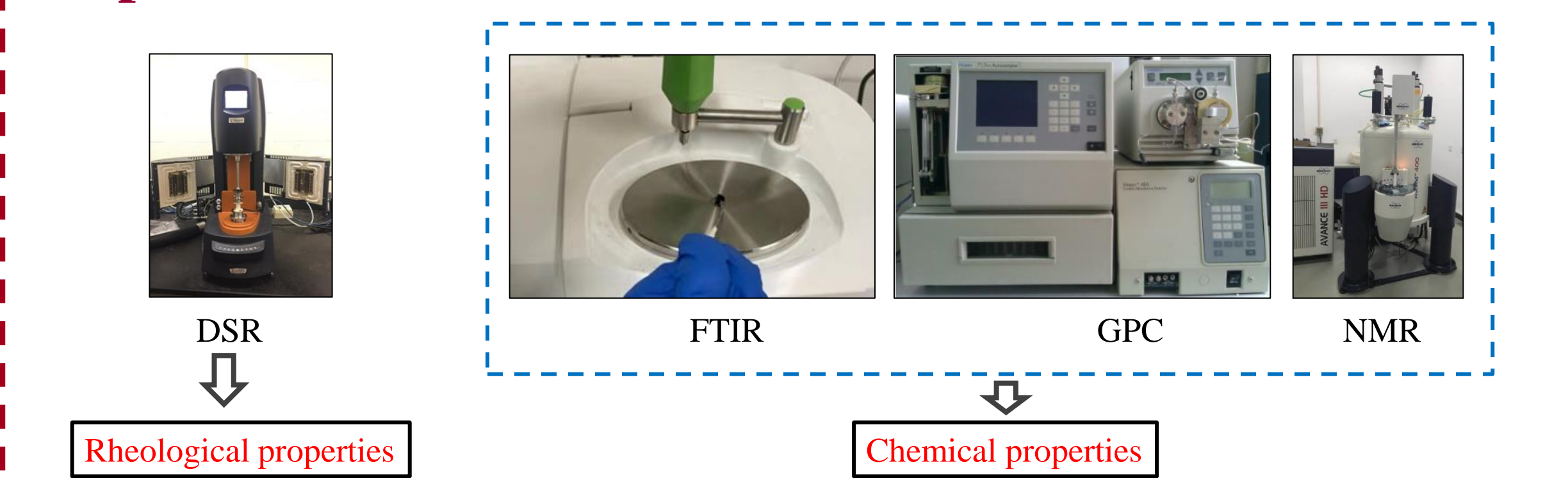
- To reveal the natural aging rule of bitumen under multi-factor coupling action in cold-arid region.
- To quantitatively evaluate the contribution rate of various natural environmental factors on bitumen aging.
- To provide the evaluation method of bitumen natural aging in cold-arid region.

METHODOLOGY

Sample preconditioning



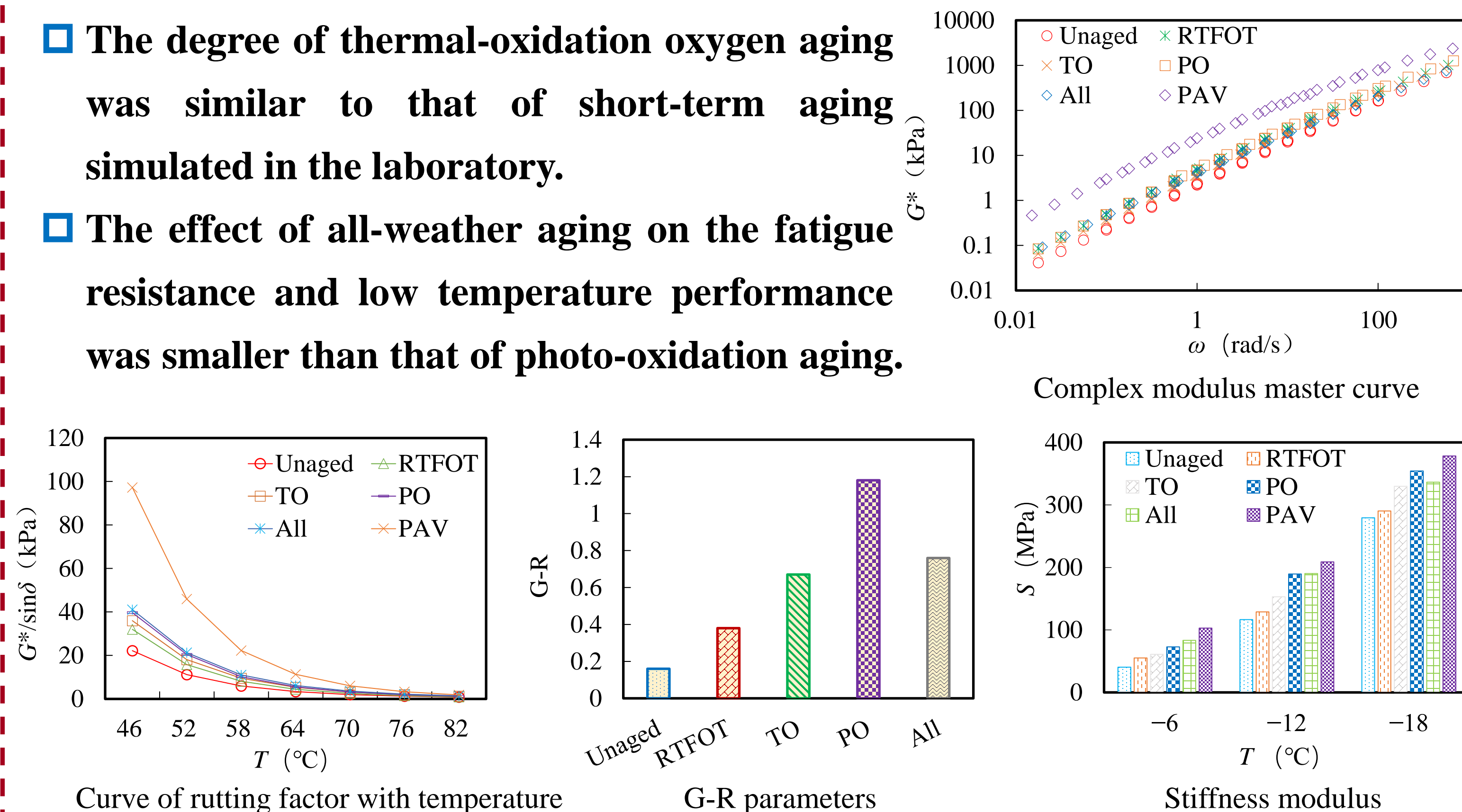
Experimental methods



RESULTS AND DISCUSSION

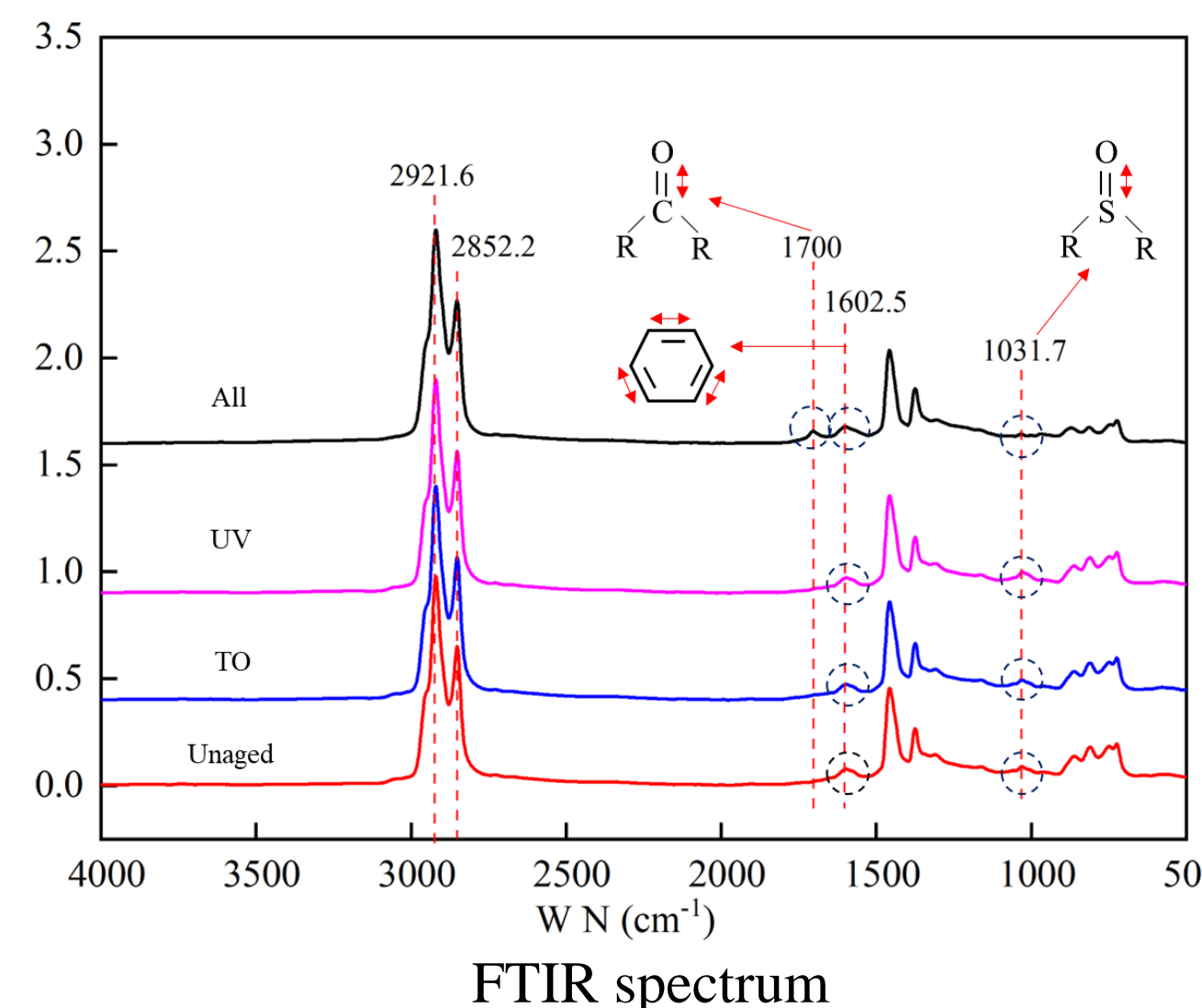
Effect of natural aging on the rheological properties of bitumen

- The degree of thermal-oxidation oxygen aging was similar to that of short-term aging simulated in the laboratory.
- The effect of all-weather aging on the fatigue resistance and low temperature performance was smaller than that of photo-oxidation aging.



Effect of natural aging on the chemical properties of bitumen

- The increment of sulfoxide group was over 10 times than that of carbonyl group.
- The average molecular weight increased by 20.5%.



Hydrogen in different structures

	H_A	H_α	H_β	H_γ
Unaged	0.057	0.130	0.635	0.178
TO	0.060	0.129	0.634	0.177
PO	0.062	0.139	0.628	0.172
All	0.095	0.100	0.577	0.227

Average molecular weight

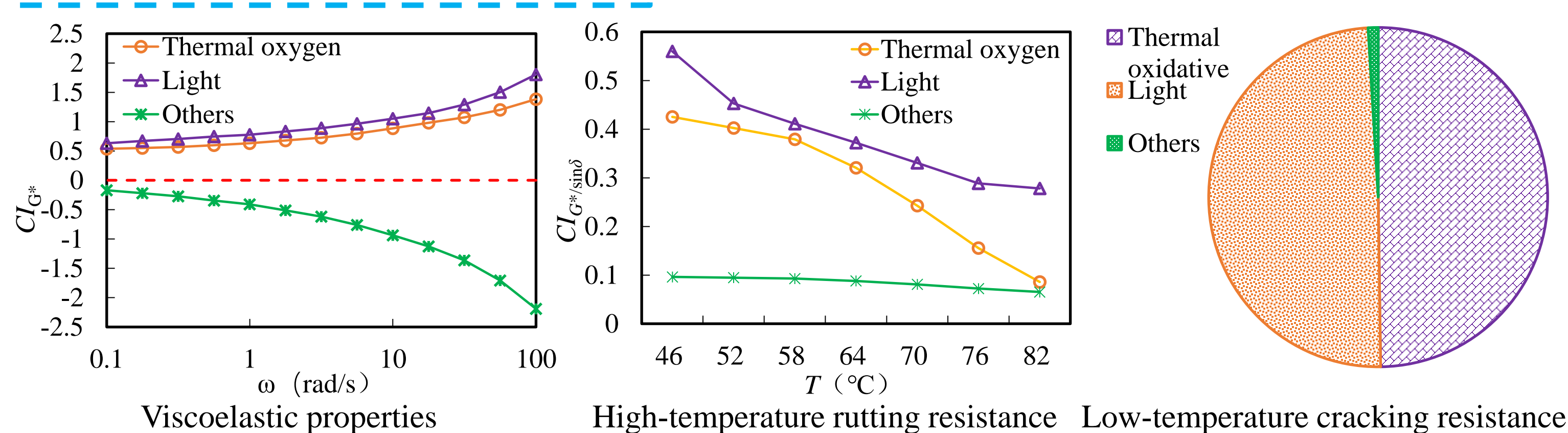
	M_n	M_w	M_z	D
Unaged	414	1144	2894	2.7633
TO	479	1213	2715	2.5324
PO	483	1267	2950	2.6232
All	499	1319	3501	2.6433

The calculated aging contribution index

The aging contribution index CI_i :

- For Thermal oxygen $CI_i = \frac{i_{TO} - i_{Unaged}}{i_{All} - i_{Unaged}}$
- For Light $CI_i = \frac{i_{TO} - i_{Unaged}}{i_{All} - i_{Unaged}}$
- For Others $CI_i = \frac{i_{TO} - i_{Unaged}}{i_{All} - i_{Unaged}}$

- The effect of light on bitumen performance was largest, whose CI was close to 0.5.
- Wind, rain and other factors played an anti-aging role on bitumen.



CONCLUSIONS

1. There was little effect on the performance of bitumen after natural aging in one year. However, the strong UV radiation was a great challenge for bitumen.
2. The content of macromolecular structures in bitumen increased due to natural aging.
3. The CI_i based on rheological parameters, directly distinguished the influence of various environmental factors on the bitumen natural aging.