Graphene oxide (GO) has widely been employed in various fields, but its structure and composition has still not been fully controlled. Based on the formation mechanism of GO, we have developed general strategies to control the oxidation degree of graphene-like materials with two types of methods: oxidation of graphite by KMnO$_4$ in H$_2$SO$_4$ (oGO), and reduction of highly oxidized graphene oxide by hydrazine (rGO). Even though the oxygen content was the same, oGO and rGO showed different properties in adsorption ability, oxidation ability, and electron conductivity, because of the difference in persisting graphitic structure and defects. These results will be a guideline for production of tailor-made GO.

Applications such as conductive films, electrodes for lithium-ion batteries, supercapacitors, and catalysts often require surface functionalizations to improve GO’s performances. Recently, adsorbents and membranes for water purification have also been recognized as promising applications of graphene-like materials. With our tailor-made GO, we developed catalyst, membrane, lubricant additive, and anode for Li-ion battery.