

### Temperature dependence of Raman spectroscopy in hydrate system

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There are many previous works for temperature dependence of Raman spectroscopies. In previous works, many systems has red shift with temperature increase. However, there are no research about inclusion compound such as clathrate hydrate. The guest molecules of clathrate hydrate have interactions with host molecules, H<sub>2</sub>O. So, there are some potential that have difference tendency of temperature dependence of Raman spectroscopic. We checked temperature dependence of Raman spectroscopic of some hydrate systems, pure CH<sub>4</sub> hydrate, pure C<sub>2</sub>H<sub>6</sub> hydrate, and mixed hydrates with CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>3</sub>H<sub>8</sub>, N<sub>2</sub>, and CO<sub>2</sub>. We found that the raman peaks of these molecules in hydrate system have blue shift. We expect that it can help to understand of clathrate hydrate system