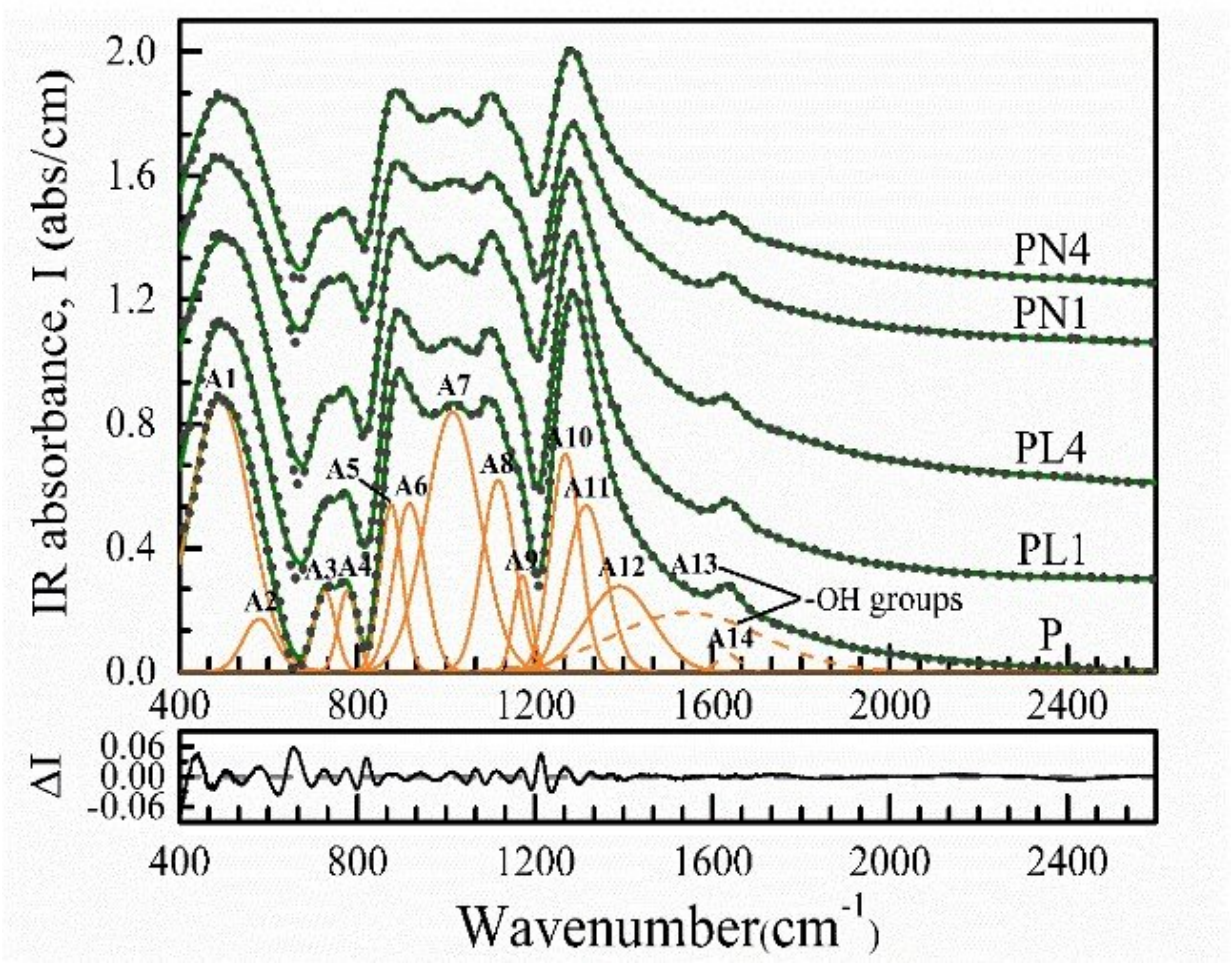
New modeling approach helps laser glass design

June 5 2020, by Zhang Nannan



Measured and curve-fitting derived IR spectra of P, PL, PN glass samples, and individual bands of P glass according to literature. Credit: SIOM

Nd-doped phosphate glasses are used in high energy / high power laser applications due to their low nonlinear refractive index and high stimulated emission cross section. In order to ensure superior properties of laser glasses, the composition of practical laser glasses is complex. However, the traditional experimental method of composition fine-tuning to improve properties of glass is slow and laborious.

Recently, a research team from Shanghai Institute of Optics and Fine Mechanics (SIOM) of the Chinese Academy of Sciences, have made progress in accurate simulation and prediction of the new developing orientation of laser glasses. The study was published in *Optical Materials*.

In the study of Nd: phosphate laser glass modified by introducing Li_2O and Na_2O, respectively, a limitation of the composition-properties (C-P) model approach was first discussed, which could not adequately simulate glass property responses. To overcome the C-P mode limitation from the single-component study, composition-structure-property (C-S-P) models were subsequently explored.

The S-P models based on curve-fitting results of the Fourier transform Infra-red (FTIR) spectra had satisfactory predictions, which transformed a problem of a given glass property response to a single (one dimensional) oxide change to a problem of the same property response to multi-directional glass structural changes. The S-P models were associated with the C-S models to establish the C-S-P models.

For the four derived glass compositions, the measured Li_2O and Na_2O concentrations and measured properties of the four glasses were very close to the C-S-P model predictions within the experimental errors, except for two cases where differences of Tg were significantly large.

In summary, the C-S-P based models can provide a new set of tools identifying important structural units that play key roles in designing new

multi-component glasses for unique properties.

The C-S-P modeling approach may accelerate compositional design work by building similar models to design/screen structure units of specific glass compositions that can simultaneously meet multiple requirements in terms of performance or processing or both.

More information: Wenxiu Liu et al. Composition-structure-property modeling for Nd3+ doped alkali-phosphate laser glass, *Optical Materials* (2020). DOI: 10.1016/j.optmat.2020.109778

Provided by Chinese Academy of Sciences