07.X-9   OPTICAL ACTIVITY AND PHASE TRANSITION.
By J.Kobayashi, Department of Applied Physics,
Waseda University, Japan.

Optical activity of a crystal takes place when
vector potential of the light beam changes
over a unit cell of the crystal. In this sense,
optical activity is microscopic in its nature,
but must be as small as in the order of a/λ ;
a being an atomic separation, and λ the wave-
length. The measurements of optical activity of
crystals were almost impossible without intro-
ducing serious approximations or only confined
to the direction of an optic axis. Recently
we developed a new method called 'HAUP'
(J.Kobayashi.J.Appl.Cryst.,1983,$\underline{16}$,204-211),by
which optical activity of crystals of any sym-
metries can be measured accurately. Thus a new
research field of crystal optics has now been
opened. We applied it to the following problems
of the phase transitions(p.t.):(1) incommen-
surate (i.c.)p.t.,(2) electrogyration effects.
As an example showing the usefulness of optical
activity applications, it was found(J.Kobayashi
et al.Phys.Rev.,1985,$\underline{B}$ $\underline{31}$,4569-4575) that in-
commensurate states of the $(NH_4)_2SO_4$ group are
optically active. The origin   of this
effect can be understood as follows; the
Fourier component of the order parameter of the
i.c.phase must be complex, the free energy of
the system does not then explicitly involve
the phase angle of the order parameter and the
transverse susceptibility becomes infinite in
the i.c.phase, which means that the hamiltoni-
an of the crystal bears continuous rotational
symmetry in the two dimensional components of
the order parameter and this symmetry of the
hamiltonian permits the optical activity. Con-
versely this study directly showed that the
order parameter of i.c. is complex and that
two modes, phason and amplitudon must exist in
this phase. We also revealed that the nearly
commensurate domains which appear in the i.c.
phases can be classified according to their
electrogyration effects(J.Kobayashi et al.J.
Appl.Cryst.1986,$\underline{19}$,377-381). In Fig.1 one of
the classes is schematically shown where the
signs of the optical activity of the domains
g_d^{ob} and soliton part g_s^{ob} differ. This class
is indeed realized   in $\{N(CH_3)_4\}_2ZnCl_4$ as
seen in Fig.2. We suggest,in
summarizing these results, that the usefulness
of optical activity may not be confined to the
study of structurally i.c.p.t., but can be
extended to reaserach on other kinds of p.t.,
where complex order parameters are condensed.
For example, the application to magnetic,semi-
conducting and superconducting transitions will
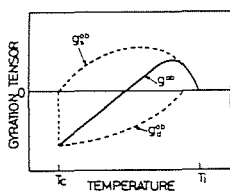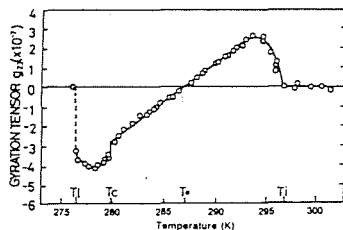be specifically promising.

Fig.1

Fig.2

07.X-10   CRYSTALLOGRAPHY   OF   THE   HIGH   CRITICAL
TEMPERATURE OXIDE SUPERCONDUCTORS.   By S.J. La Placa,
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The discovery by Bednorz and Muller of a 40K class of
high T_C oxide superconductors, and the more recent
success of Chu and co-workers in reaching the 90K range,
have led to a progression of scientific activity
unparalleled in the history of research. After a
discussion of superconductivity and its technological
implications, a crystallographic and chemical overview
will be given. The importance of oxygen stoichiometry
and disorder will be detailed for the high temperature
transformation of the 90K $Ba_2YCu_3O_{7-\delta}$ phase.

07.X-11   COMPOSITION, STRUCTURE AND STABILITY OF
$YBa_2Cu_3O_x$. By B.G. Hyde, Research School of Chemistry,
Australian National University, Canberra, A.C.T.,
Australia [representing a group including members of
the Australian National University, Canberra, A.C.T.;
the Australian Institute of Nuclear Science and
Engineering, Lucas Heights, N.S.W.; the C.S.I.R.O.
Division of Applied Physics, West Lindfield, N.S.W.;
and the University of Western Australia, Nedlands,
W.A.].

Fairly pure (>95%) superconducting $YBa_2Cu_3O_x$ (x = 6.5?)
corrodes readily in air under ambient conditions. More
extreme conditions (air saturated with water vapour at
$40°C$) cause very rapid degradation (~25% in 16 hours).
At the earliest stages lamellar faults appear in
electron microscope images of the (previously perfect)
orthorhombic, oxygen-deficient, "perovskite"
superstructure. As the reaction proceeds, the
identified corrosion products are $Ba_2Cu(OH)_2$, $BaCO_3$, CuO
and $Y(OH)_3$.

The corrosion process quickly destroys the
superconductivity. The "same" material with a lower
oxygen content (x = 6.5?) corrodes at a much lower rate,
if at all, in air. It seems likely that this is because
the superconductor (x > 6.5) contains trivalent copper
[Cu(III), a powerful oxidising agent] whereas the
reduced material (x = 6.5) does not: $O_{6.5}^{2-}$ being
charge-compensated by $Y^{3+}Ba_2^{2+}Cu_3^{2+}$.

Various techniques are being used to investigate this
and related questions.