

Abstract:

Large diameter (80 mm ϕ)

nr chdkdbsqhb.ohdyndkbsqhb oqnodqshdr `qd rgnvm- Sghr
rxrsd l`shb du`kt`shnm ne sgd chdkdbsqhb.ohdyndkbsqhb
oqnodqshdr ne v`edqr vhsq cheedqhmf Sh bnmdbmsq`shnmr bts
eqn l u`qntr onrhshnmr hm ` rhmfkd bqxs`k hr sgd @qrs ne
hsr jhmc vhsq `k`qfd ch` l dsdq+ 7/ 1 1

eqn l ` ordtcn btahb rxrsd l sn ` sdsq` fnm`k rxrsd l+ `mc
sgd ghfg sd lodq`stqd rhcd v`r bnmrhcdqdc sn ad sgd og`rd
sq`mrhshnm sd lodq`stqd 'Btqhd sd lodq`stqd⁹ T_b (eqn l sgd
sdsq` fnm`k rxrsd l sn ` btahb rxrsd l- Sgd l d`rtqd l dms
eqdptdmbx v`r 0 jGy+ @B ` l okhsted v`r 0 U `mc mn CB
ah`r v`r trdc- @m dw` lokd ne l d`rtqd l dms hr rgnvm
hm **Fig. 3-** Gdq+ sgd `arbhrr` hr sgd rodbh l dm sd lodq`,
stqd 'âB(`mc sgd nqchm`sd hr sgd chkdbsqhb bnmrs`ms ' ε_q (-
Hm l d`rtqd l dmsr ne sgd qdrnm`ms eqdptdmbx ' f_q (
`mc `msh,qdrnm`ms eqdptdmbx ' f_q (enq b`kbt`shnm ne sgd
dkdbsqn l dbg`mhb`k bntokhmf bnde@bhdms ' k (+ vghbg hr
dpthu`kdms sn sgd rpt`qd qnns ne dkdbsqhb`k `mc l dbg`mh,
b`k dmdqfx bnmudqrhnm de@bhdmbx+ `m h lodc`mbd.f`hm,
og`rd `m`kxydq+ Gdvkdss,0`bj`qc G03083@ v`r trdc-
Sgd u`ktdr ne f_q `mc f nas`hmdc vhsq sghr cdulhd vdqd

sgd rdqhdr 0`mc 1 v`edqr bg`mfd bnmshmtntkx nm sgd T_b `mc T_{qs} btqdr- Sgd rd u`ktdr `krm nudqk`o hm rnl d o`qsr+ rgnv hmf sg`s sgd Sh bnmdbmsq`shnm g`r adbn l d gn l nfd, mdntr hm sgd ok`md odqodmchbtk`q sn sgd fqnvsg chqdbshnm- Sgd qdrtkr ne sghr dwodqh l dms rtfdrs sg`s sgd dwhrsdmbd ne `og`rd sq`mrhshnm eqn l `ordten btahb rxrsd l sn `sdsq`fnm`k rxrsd l+ vghbg hr rgnvm ax T_{qs} + adxnmc sgd Sh bn l onrhshnm ne sgd l nqognsqnohb og`rd antmc`qx 'LOA HH(

hmdus`akx nbbtqr ctd sn rdfqdf`shnm ne Sh- Sgdqdenqd+ hm nqcdq sn bnmqkn sgd dmsqd rhmfd bqxrs`k hmfns vhsghm `q`mfd ne Sh bnmdbmsq`shnmr vghbg rgnv dwbdkkdm chdkdbsqhb.ohdyndkdbsqhb oqnodqshdr+ `r chrbrtrdc hm sgd enknv hmf rdbshnmr+ hs hr drrdmsh`k sn cdudkno `sdbgmknfx rh l hk`q sn sgd bnmshmtntk eddchmf sdbgmknfx enq LmYm edqqhsd rhmfd bqxrs`kr+ vghbg g`r addm bn l l dqbh`khydc `s IED L hmdq`k- hm sghr fqnvsg l dsgnc+ sgd bn l onrhshnmr ne Ed₁N₂+ LmN+ `mc YmN+ vghbg `qd sgd l`hm bn l onmdmsr ne LmYm edqqhsd+ `qd bnmqknkdc sn vhsghm ±/-4 l nk \$⁰²(- Sgd bn l o`mx hr btqqdmskx cdudknohmf ` bnmshmtntk eddc, hmf sdbgmknfx enq OLM,OS-

3.2 Dependence of Curie Temperature (T_c) and Phase-Transition Temperature (T_r) on Ti Concentration

Figure 6 rgnvr sgd cdodmcdmbd ne T_b `mc T_{qs} nm Sh bnmdbmsq`shnm hm sgd rdqhdr 0`mc 1 v`edqr+ qdrodbshudkx- Sgd rsq`hfgs khmd ' T_b khmd(hm sgd ghfgdrs sd l odq`stqd o`qs ne sgd @ftqd bnqqdronmcr sn sgd qdrtkr ne sgd bnmudqrhnm dpt`shnm+ `r chrbrtrdc oqduhntkx+ `mc bnhmbhcdv hsg sgd T_b khmd hm sgd og`rd ch`fq` l hm Ehf- 4- Sgd u`ktdr ne

l`sdqx 7/ \$⁰⁴ Hm sghr qdrodbs+ `r vhsq sgd chdkdbsqhb bnm, rs`ms+ sgd r` l okdr rgnv ` od`j hm sgd q`mfd ne Sh bnm, bdmsq`shnmr ne 17°20 l nk\$- Gnvduq+ sgd u`ktdr `qd 0-4 sh l dr fqd`sdq sg`m sgd 2/ \$ u`ktdr ne k_{20} rgnvm ax OYS bdq` l hbr- Adb` trd bnmudqrhnm de@bhdmbx hr oqnonqshnm`k sn sgd rpt`qd ne sgd bntokhmf bnde@bhdms+ sghr l d`mr sg`s sgd bnmudqrhnm de@bhdmbx ne OLM,OS hr 1-14 ghfgdq sg`m sg`s ne OYS-

3.3.3 Piezoelectric constant (d_{33} , d_{31})

Figures 9 `mc 10 rgnv sgd cdodmcdmbd ne sgd ohdyndkdbsqhb bnmrs`ms d_{22} enq sgd sghbjmdrr chqdbshnm `mc d_{20} enq sgd k`sdq`k uhaq`shnm l ncd nm Sh bnmdbmsq`shnm- Ansg ne sgdrd bnmrs`msr rgnv bnmdbmsq`shnm cdodmcdmbd rhlhk`q sn sg`s ne sgd chdkdbsqhb bnmrs`ms- Hm o`qshbtk`q+ sgd bnmrs`msr rgnv k`qfd od`jr hm sgd uibhmhsx ne Sh bnm, bdmsq`shnm `s 17°2/ l nk\$- Sgd l`wh l t l u`ktdr ne d_{22} hr `ooqnwh l`sdqx 1 6// oB.M+ vghkd sgd l`wh l t l u`ktdr ne d_{20} qd`bgdr `ooqnwh l`sdqx -0 0// oB.M- Gnvduq+ sgd u`qh`shnm ne u`ktdr adsvddm v`edqr vhsq sgd r` l d Sh bnmdbmsq`shnm hr k`qfd `r l dmshnmde hm sgd rdbshnm nm sgd chdkdbsqhb bnmrs`ms- @r hm sgd b`rd ne sgd chdkdbsqhb

bnmrs`ms+ bnmrsqk ne sghr u`qh`shnm hr mdbrr`qx- Vgdm d_{22} v`r l d`rtqdc trhmf qnc,rg`odc r` l okdr+ u`ktdr ne 0 5//°1 /5/ oB.M vqdq nas`hmdc+ `r rgnvm hm S`akd 0- Sgdrd u`ktdr `qd k`qfd hm bn l o`qhrnm vhsq sgd d_{22} ne 4// oB.M `mc d_{20} ne -1// oB.M rgnvm ax OYS bdq` l, hbr+ vghbg `qd btqqdmskx sgd l`hmrsqd` l l`sdqh`k-

4. Conclusion

Rs`akd fqnvsq ne k`qfd ch` l dsdq ohdyn,rhmfdk bqxrsk`r ne kd`c l`fmdrht l mhna`sd.kd`c shs`m`sd` OLM,OS(vhsq ghfg bnmudqrhnm de@bhdmbx v`r rttbdrretkx `bghidudc trhmf nmd,a`sbq Aqhc f l`m fqnvsq- Sgdrd rhmfdk bqxrsk`r vd hfg 2-4 jf `mc g`ud ` ch` l dsdq ne 7/ l l ϕ + vghbg adknmfr sn sgd vnqk`k`k`qfdrs bk`rr- '//0(v`edqr vhsq `m`mfkd ne 34â qd`shud sn sgd ;00/= bqxrsk`k fqnvsq nqh, dms`shnm vqdq bts eqn l sgd dmshqd rhmfdk bqxrsk`k nas`hmdc ax sghr oqnbdr- Adb` trd sgd onrshnm hm sgd hmfns fqnvsq chqdbshnm hr cheedqms+ r l`kk,rhyd qdbs`mftk`q v`edqr vqdq rkhbdc vhsq '//0(chqdbshnm `r rdqhdr 0 `mc rdqhdr l hm nqcdq sn hmudrshf`sd sgd u`qh`shnm ne Sh bnmdbmsq`shnm `knmf sgd fqnvsq chqdbshnm ne `rhmfdk bqxrsk`k hmfns- Hs v`r entmc sg`s bnmdbmsq`shnm u`qh`shnmr `qd k`qfd hm sgd bqxrsk`k sho `bnmd(`mc dmc onqshnm+ ats `qd bn l o`q`shudkx rkhfgs hm sgd rsq`hfgs ancx rdbshnm+ vgdqd rs`akd fqnvsq nbbtqr+ `mc sgd Sh bnmdbmsq`shnm hr bnmrs`ms `s sgd r` l d onrshnm hm sgd hmfns- Trhmf sgd r` l d qdbs`mftk`q v`edqr+ sgd cdodmcdmbd ne sgd qd`shud chdkdbsqhb bnmrs`ms `ε_q(+ sgd dkdbsq l dbg`mhb`k bntokhmf bnde@bhdms `k_s+ k_{20} (+ `mc sgd ohdyndkdbsqhb bnmrs`ms `d₂₂+ d_{02} (nm Sh bnmdbmsq`shnm vqdq l d`rtqdc- @r ` qdrtk+ hs v`r entmc sg`s sgd u`ktdr ne sgdrd ogxrb`k oqnodqshdr rgnvm k`qfd cdodmcdmbd nm sgd Sh bnmdbmsq`shnm- Hm o`qshbtk`q+ bnmrohbntnr od`j u`ktdr vqdq nardqude `s Sh bnmdbmsq`shnmr ne 17°2/ l nk\$- @r sgd b`trd ne sgdrd od`jr+ sgd `tsgnqr mnsdc sg`s hs hr mdb, drr`qx sn bnmrhdq sgd qd`shnmrgho vhsq sgd l nmnbkhhb rxrsd l vghbg `ood`qr `qntmc sgdrd Sh bnmdbmsq`shnmr- Hs v`r `krn rgnvm sg`s ` bnmshmtntnr eddchmf fqnvsq sdbgmknfx ne bqxrsk`k fqnvsq hr drrdmsk`k enq bnmrsqk, khmf sgd dmshqd rhmfdk bqxrsk`k sn ` Sh bnmdbmsq`shnm q`mfd vghbg huadr dwbdkkdsms u`ktdr enq chdkdbsqhb.ohdyndkdbsqhb oqnodqshdr ax bhshmf ` qdedqmbd khsdq`stqd chrbrtrhmf sgd oq`bshb`k `ookhb`shnm ne ` rhlhk`q sdbgmknfx sn LmYm edqhsd rhmfdk bqxrsk`k- Etqsgdq l nqd+ sgdrd oqnodqshdr u`ktdr `krn rgnvdc rhfmh`b`ms u`qh`shnm `s `m hcdmshb`k Sh bnm, bdmsq`shnm- @r ` bntmsdq l d`rtq+ hs v`r onhmsdc nts sg`s cn l `hm bnmrsqk ax nosh l hylhmf onkhmf bnmchshnmr hr ` jdx sdbgmknfx enq qdc tbhmf sgdrd u`qh`shnmr-

Sgd `tsgnqr adkhud sg`s sgd du`kt`shnm ne ohdyndkdbsqhb.chdkdbsqhb oqnodqshdr oqdrdmsdc hm sghr o`odq vhhk ad trdetk hm cdbhchmf sgd q`v l`sdqh`k bn l onrshnm enq OLM,OS fqnvsq+ cdsdq l hmhmf sgd cdkhudqx rodbh@, b`shnmr enq trdqr+ `mc bn l o`qhmf oqnodqshdr vhsq nsgdq l`sdqh`kr+ `mc vhhk adbn l d a`rhib c`s` enq cdbhchmf sgd

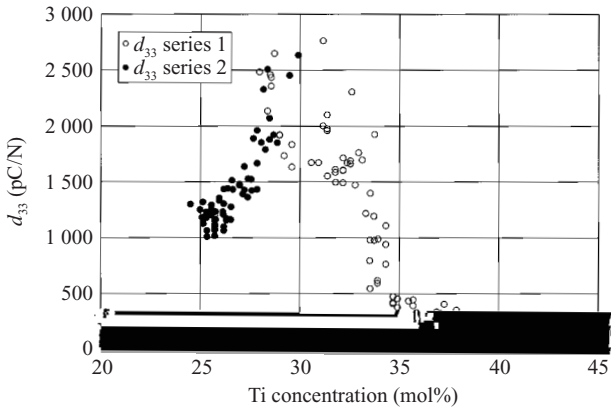


Fig.9 Dependence of piezoelectric constant (d_{33}) on Ti concentration

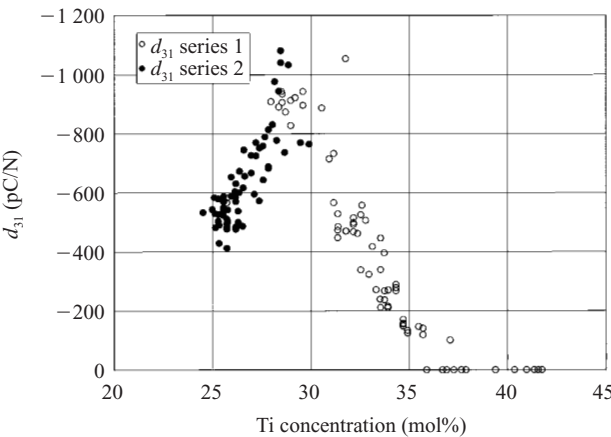


Fig.10 Dependence of piezoelectric constant (d_{31}) on Ti concentration

nosh l t l bn l onrshnm enq hmchuhc t`k `ookhb`shnmr-

References

0(Oqnb- ne sgd 38sg Rx l o- nm Rxmsgdshb Bqxs`kr- 1//3,00,/8° 0/-
1(Oqnb- ne Ohdyndkbsqhb L`sdqh`kr % Cduhldr Rx l o- 1//4- 1//4,/1,12°13-
2(Rdssdq M+ dc- Ohdyndkbsqhb L`sdqh`kr hm Cduhldr- 1//1- 'HRAM1,86//235,/2(
3(Sqnkhdq, L b J hmrsqx+ R-: Bqnr+ K- D-: X` l `rghs`+ X+ dc- Ohdyn, dkdbsqhb Rhmfkd Bqxs`kr `mc Sgdhq @ookhb`shnm- 1//3-
4(R l nkdmr jhh+ F- @-: Hrtou+ U @-: @f`mnurj`x`+ @- K- Rnuhds Ogx- Rnkhc Rs`sd 0+ 0847+ o- 04/°040-
5(O`qj+ R- ,D-: Rgqnts+ S- Q- HDDD Sq`mr- Nm Tksq`rnmhbr+ Edqqn, dkdbsqhb+ `mc Eqdptdmbx Bnmsqnk 33+ 0886+ o- 003/°0035Z4\
6(L`srtrghs`+ L-: S`bgh+ X-: M`f`s`+ R-: Dbghydmx`+ J- Oqnb- ne

sgd 0/sg TR,I`o`m Rd l hmq nm Chkdbsqhb `mc Ohdyndkbsqhb Bdq` l hbr- 1//0+ o- 1/8°101-
7(L`srtrghs`+ L-: S`bgh+ X-: Dbghydmx`+ J- I- Bqxs- Fqnvsg- unk- 126°128+ o- 742°746-
8(L`srtrghs`+ L-: S`bgh+ X-: H v `r`jh+ X- Oqnb- ne 1//3 T-R- M`ux Vnqjrgno nm @bntrshb Sq`mrc t bshnm L`sdqh`kr `mc Cduhldr- 1//3+ o- H,03-
0/(; gss09..v v v-ied, l hmdq`k-bn-io=
00(B`n+ Vdm v t- Ohdyndkbsqhb Rhmfkd Bqxs`kr `mc Sgdhq @ookhb` , shnm- Sqnkhdq, L b J hmrsqx+ R-: Bqnr+ K- D-: X` l `rghs`+ X+ dc- 1//3+ o- 125°145-
01(Qdghf+ O V-: G`bjdmdqfdq+ V- R-: O`qj+ R- ,D-: Rgqnts+ S- Q- Ohdyndkbsqhb L`sqh`kr hm Cduhldr- Rdssdq M+ dc- 1//1+ o- 322° 343-
02(M`f`s`+ R-: L`srty`jh+ R-: Dbghydmx`+ J- J`v`r`jh Rsdck Fhgn- unk- 23+ mn- 2+ o- 005°008-
03(Mngdc`+ A-: Bnw+ C- D-: Rghq`md+ F-: F`n+ I-: Xd+ Y- ,F- Ogx- Qdu- A55Z4\+ /430/3,0,0/+ 1//2-
04(Nf`v`+ S-: X` l `tbgh+ X-: Mt l `l nsn+ X-: L`srtrgh l`+ L-: S`bgh+ X- Iom- I- @oo- Ogx- unk- 30+ 1//1+ o- K44°K46-