phonon mode vibration respectively of AlN in Fig. 2, after ion irradiation, the peak position is obvious spreading with the increase of irradiation dose. Irradiation made the Al-N bonds fracture and formed Al-O bonds.

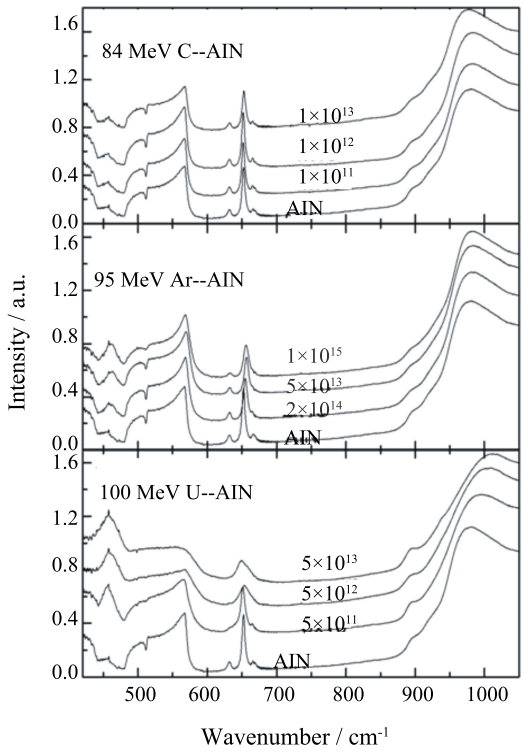

Fig. 1 (color online) FTIR spectra of AlN irradiated with high energy ions.

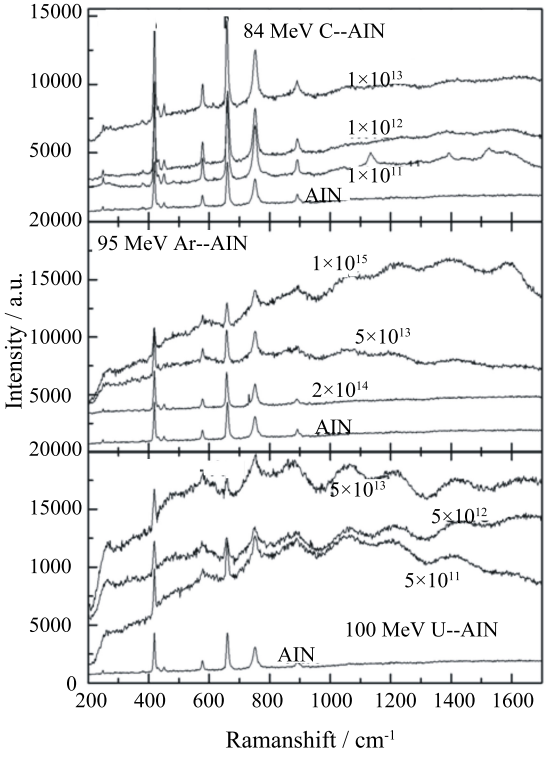

Fig. 2 (color online) Raman shift of AlN irradiated with high energy ions.

3 - 27 Characteristics of Luminescence of N Ion Irradiated LED

Gou Jie, Zhang Chonghong, Song Yin, Yang Yitao, Yi Xiaoyan, Wei Xuecheng, Xie Haizhong, Liu Juan, Xian Yongqiang and Zhang Liqing

In the present work, the LED chip was irradiated by using 59.6 MeV N ions in a terminal chamber of the Sector-focused cyclotron (SFC) in the National Labortary of Heavy-ion Accelerators in Lanzhou. The 63 MeV N ions penetrated through a gold foil and scattered in a large area. The energy of ion was reduced to 59.6 MeV after scattering of the gold foil. The LED was provided by the Semiconductor Lighting Center in Institute of Semiconductor in Beijing. The luminences of the LED before/after irradiation were tested through a integrating sphere in Semiconductor Lighting Center in Institute of Semiconductor in Beijing. The luminance was tested under a current of 350 mA. Fig. 1 shows the relationship between the luminences and the irradiation fluences. The irradiation led to the drop of the luminance intensity and the fluctuation around 6.7 lm when the fluences between 3.1×10^6 ions·cm^{-2} and 6.2×10^8 ions·cm^{-2}. The luminance reached its peak 6.864 lm, which is 93.8% of the unirradiated sample, when the fluences reached 6.2×10^8 ions·cm^{-2}. The luminance decreases when the fluences exceeded 6.2×10^8 ions·cm^{-2}. The luminance dropes to 70% of the effects of the unirradiated sample when the fluences reached 6.2×10^9 ions·cm^{-2}. The luminances dropes to 0.64 lm when the fluences reached to 8.2×10^{10} ions·cm^{-2}, which is 8.6% of the efficiency to the pristine samples. These data are very useful to understand the degradation mechanism of the LED[1]. The variation tendency of Fig. 1 is very similar to that of the stress ti-

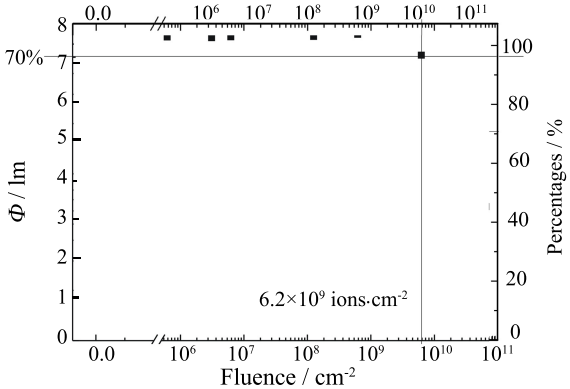

Fig. 1 The relationship between the luminance and the irradiation ion fluence.

me degeration behavior of the LED. The mechanism of the irradiation induced LED luminance degration may be releated to the worsening of the chip which is induced by the energy release of the heavy ions.

Reference

[1] C. T. Zhong, T. J. Yu, J. Yan, et al., Chinese Physics B, 22(2013)(11).

3 - 28 Progress on Mutation Breeding Induced by Heavy Ion Beams and Planting Sweet Sorghum

Zhou Libin and Li Wenjian

During the past year, biophysics group at Institute of Modern Physics (IMP) obtained lots of achievements in the research of heavy-ion mutation breeding and production chain of sweet sorghum. In fundamental research field, a mutant population of *Arabidopsis thaliana* induced by carbon ion beam radiation was established in M2 generation. The total mutation rate was 4.77%. A mutant marked 197#, which had frostbite-like, pale green, wrinkled and uneven leaves and displayed loose bracts and late maturation, was obtained and reported for the first time. Gene rough mapping results demonstrated that there were two mutation sites in the 1st and 4th chromosome of 197# mutant, indicating heavy ion radiation might induce more complicated mutations beyond our current recognition. The whole genome resequencing of this mutant is still in progress. In addition, high-yield strains of microbes which have potential value for commercial application, such as *Corynebacterium glutamicum* and *Lacbobacillus thermophiles*, were screened using heavy-ion mutation technique.

In 2014, two new varieties of sweet sorghum were obtained and certificated by Gansu Crop Variety Approval Committee. A new crossing combination marked FK01 of oil-sunflower with ideal agronomic characters were tested in Gansu regional trails. Two invention patents about yeast fermentation technique were approved by State Intellectual Property Office of China. It was worth noting that, under the support of local government, IMP set up Gansu Engineering Laboratory of Radiation Mutation Breeding in Wuwei city in this year. The aim of this laboratory is to promote the application of heavy ion beam radiation technique in mutation breeding, to breed new varieties of crop suitable for planting in northwestern China and to create a full value production chain of sweet sorghum. In 2014, about 16,000 hectares cultivation of sweet sorghum was promoted in Gansu province. Meanwhile, several specific products, such as ethanol, silage, yeast extract, glucan, citric acid and glutamic acid, were produced using sweet sorghum as raw materials. The whole demonstration of production chain of sweet sorghum and heavy-ion mutation breeding technique has created a number of disseminations, such as reports published by two newspapers and a television documentary, *etc.* In addition, IMP has established tight collaborations for mutation breeding research with many institutes or universities in China.

3 - 29 Oil-sunflower New Strain FK01

Qu Ying, Li Wenjian, Jin Wenjie and Yang Jiangyan

FK01 is a new strain of oil-sunflower with cytoplasmic male sterile line HA as female parent and cytoplasmic male sterile restorer line 19540 as male parent. 19540 is a mutant irradiated by carbon ion which seed oil content increases.

FK01 joined 2014 Gansu province regional test of oil-sunflower and planted in six sites: Jingyuan agricultural technique spreading center, Minqin agricultural technique spreading center, Jingtai agricultural technique spreading center, Jiuquan agricultural sciences research institute, Tianshui agricultural sciences research institute, and Huanxian seed control station. The test results showed that average yield of FK01 was 242.9 kg per Mu which increased 9.1% compared with control. The growth period of FK01 was 117 d, which later 3 d than control. The plant height was 150.0 cm, and disc diameter was 17.5 cm. Hundred-grain weight was 7.1 g. Disk inclination was three levels. Maturing rate was 91.3%. Seeds weight per plant was 84.7 g. The kernel percent was 76.6%. The data suggested that FK01 continue to attend Gansu province regional test of oil-sunflower in 2015.