The Mass-metallicity Relation at $z\sim1.4$ Revealed with Subaru/FMOS

YABE, Kiyoto (NAOJ)
OHTA, Kouji, IWAMURO, Fumihide (Kyoto University)
AKIYAMA, Masayuki (Tohoku University)
TAMURA, Naoyuki (University of Tokyo, Kavli IPMU)
YUMA, Suraphong (University of Tokyo, ICRR)
KIMURA, Masahiko, TAKATO, Naruhisa (NAOJ)
MORITANI, Yuki (Hiroshima University)
SUMIYOSHI, Masanao, MAIHARA, Toshinori (Kyoto University)
SILVERMAN, John (University of Tokyo)
DALTON, Gavin, LEWIS, Ian, BONFIELD, David, LEE, Hanshin, CURTIS LAKE, Emma
MACAULAY, Edward, CLARKE, Fraser
(Oxford University)

The gas-phase metallicity (hereafter metallicity) is one of the important parameters in understanding the galaxy formation and evolution. It is known that the metallicity of galaxies correlates well with the stellar mass in the local Universe. This mass-metallicity relation still remains unclear at higher redshift partly due to the small sample size. We have carried out a NIR spectroscopic survey of star-forming galaxies at $z\sim1.4$ by using FMOS (Fibre Multi Object Spectrograph) [1] on the Subaru Telescope. We reported initial results [2] of this survey in the *NAOJ Annual Report 2012*. Here, we report the mass-metallicity relation at $z\sim1.4$ constructed by using the new results including the initial results [3].

We observed ~1200 target galaxies with $K<23.9$ mag (AB), $1.2\leq z_{ph}\leq1.6$, $M_*\geq10^{9.5}M_\odot$, $F(\mathrm{H}\alpha)^{expected}\geq5\times10^{-17}\,\mathrm{erg\,s^{-1}\,cm^{-2}}$ in the SXDS (Subaru XMM-Newton Deep Survey) field during the FMOS/GTO. The basic data reduction was done with the FMOS standard pipeline, and the spectral fitting including the effects of OH-masks was carried out. For 343 objects, Hα emission lines are detected with signal-to-noise (S/N) ratio larger than 3. The metallicity is obtained from [N II]λ6584/Hα line ratio, after excluding possible candidates of active galactic nuclei (AGNs). Due to the faintness of the [N II] λ6584 lines, we apply the stacking analysis and construct the mass-metallicity relation at $z\sim1.4$.

We compare the mass-metallicity relation of our sample to the past results at different redshifts from $z\sim3$ to $z\sim0$ in literature. We found that the resultant mass-metallicity relation at $z\sim1.4$ is located between those at $z\sim0.8$ and $z\sim2.2$; the metallicity increases with decreasing redshift from $z\sim3$ to $z\sim0$ at fixed stellar mass. Thanks to the large size of the sample, we are able to study the dependence of the mass-metallicity relation on various galaxy physical properties. The average metallicity from the stacked spectra is close to the local fundamental metallicity relation (FMR) in the higher metallicity part, but is > 0.1 dex higher in metallicity than the FMR in the lower metallicity part. We found that galaxies with larger $E(B-V)$, $B-R$, and $R-H$ colours tend to show higher metallicity by ~0.05 dex at fixed stellar mass. We also found relatively clearer size dependence that objects with smaller half light radius tend to show higher metallicity by ~0.1 dex at fixed stellar mass, especially in the low mass part. These dependences can be partly explained by scenarios such as in-falling of metal-poor gas, outflow of enriched gas, and different star-formation efficiency.

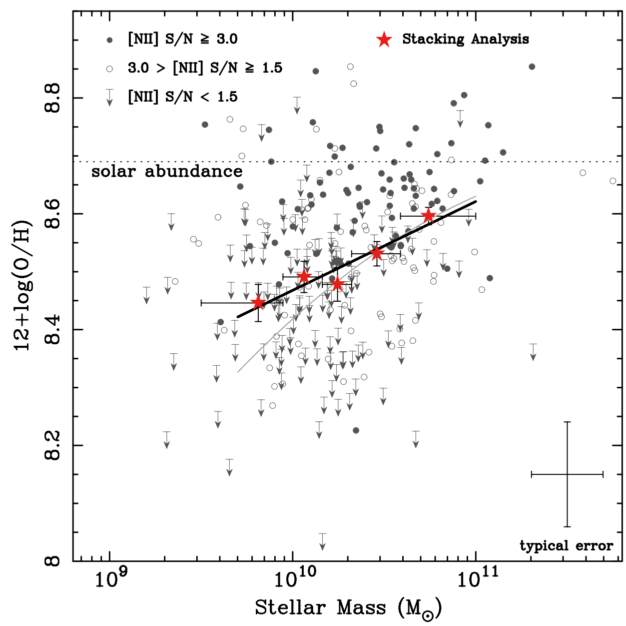

Figure 1: The mass-metallicity relation at $z\sim1.4$. Objects with [N II]λ6584 S/N ratio of ≥3.0, 1.5 – 3.0 and < 1.5 are indicated by filled, open circles and upper limits, respectively. Results from the stacking analysis are shown by filled stars with bootstrap error bars and linear fit (thick line). The initial result is indicated by thin line. The typical error for an individual object is presented on the bottom-right corner.

References

[1] Kimura, M., et al.: 2010, *PASJ*, **62**, 1135.
[2] Yabe, K., et al.: 2012, *PASJ*, **64**, 60.
[3] Yabe, K., et al.: 2014, *MNRAS*, **437**, 3647.