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Spectral characteristics of ethylene sorbed by silver-containing ionic liquids studied by *in situ* ATR-FTIR spectroscopy

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Experimental

All solvents were purchased from company listed in the Table S1 and were used without further purification. $AgNO_3$ (LenReactiv, 99.9%) was applied to prepared AgCl and AgBr as described in [1]. AgOAc was made through Ag_2CO_3 by precipitation of $AgNO_3$ with Na_2CO_3 and subsequent dissolving in HOAc.

Table S1 – Solvents

Solvent	Company
$NH_{3\ aq}$	AO REAHIM
$C_2H_4(OH)_2$, (EG)	ACOS-1
$C_{12}H_{26}$ (dodecane)	AO REAHIM
$[C_4Mim][PF_6]$	Alfa Aesar
$[C_4Mim][BF_4]$	Alfa Aesar
$[C_4Mim][OAc]$	Tokyo Chemical Industry
$[C_4Mim][HSO_4]$	Tokyo Chemical Industry
$[C_4Mim][C_8H_{17}OSO_3]$	Alfa Aesar
$[C_6Mim][Cl]$	Sigma Aldrich
$[C_6Mim][Br]$	Sigma Aldrich

Ethylene (99.9%) were purchased from "Clean Gases" (Novosibirsk, Russia) and were employed without further purification. Hydrocarbon at high pressure was supplied using a hand pump (HiP 87-6-5), the pressure was monitored using an electronic manometer with pressure accuracy ±1 atm.

ATR-FTIR spectra

ATR-FTIR spectra were obtained using a Bruker Vertex 70V FTIR spectrometer with a MCT single-element detector at the temperature of 25 °C (± 1 °C). The spectral resolution was 1 cm^{-1} and 128 co-added scans were used for all measurements.

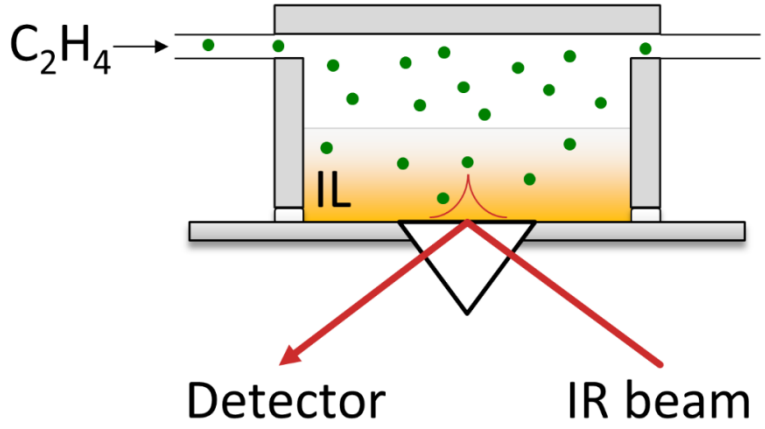

Figure S1 – Schematic of high-pressure cell attached to the ATR accessory.

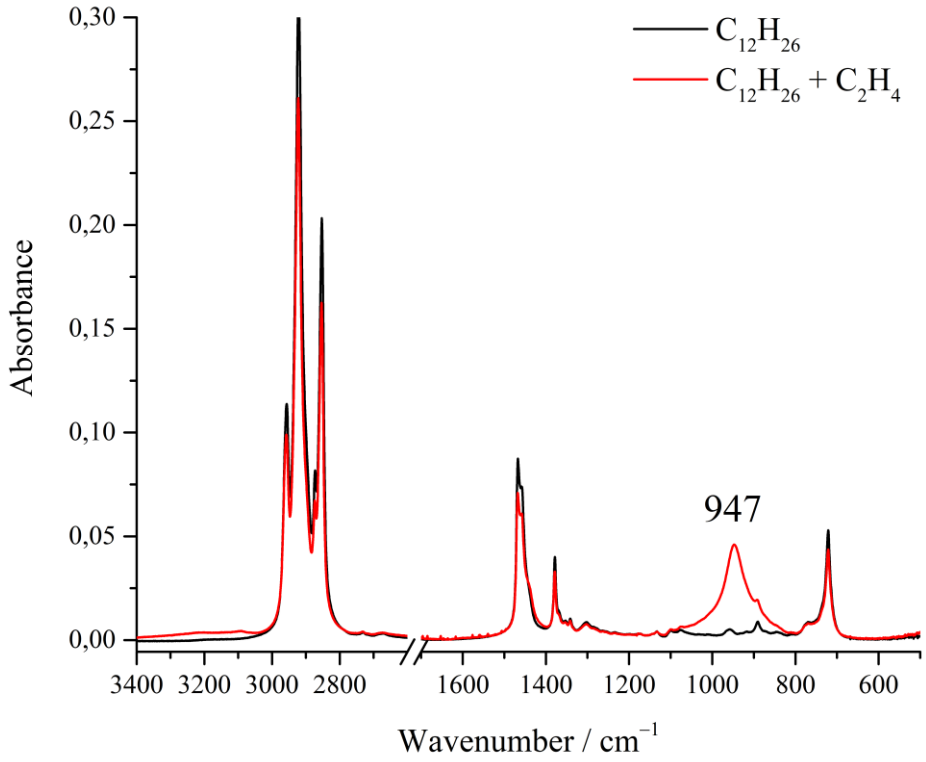

Figure S2 – ATR-FTIR spectra of dodecane ($C_{12}H_{26}$) at atmospheric pressure and ethylene pressure of 20 atm.

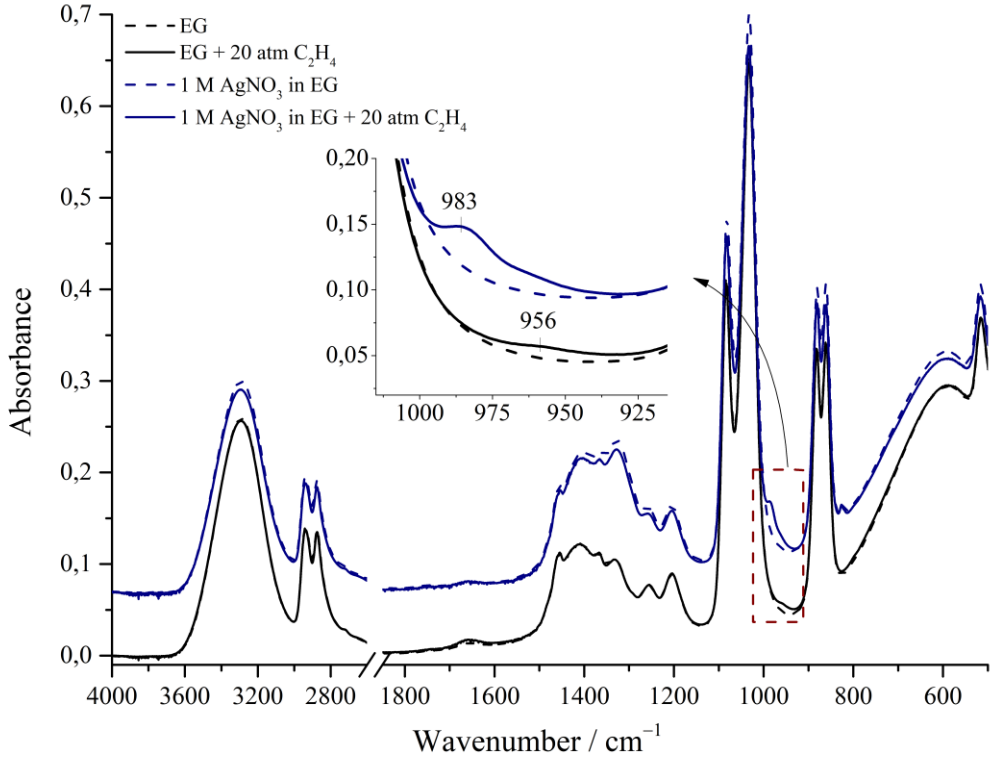

Figure S3 – ATR-FTIR spectra of EG at atmospheric pressure and ethylene pressure of 20 atm, including those with the addition of $AgNO_3$.

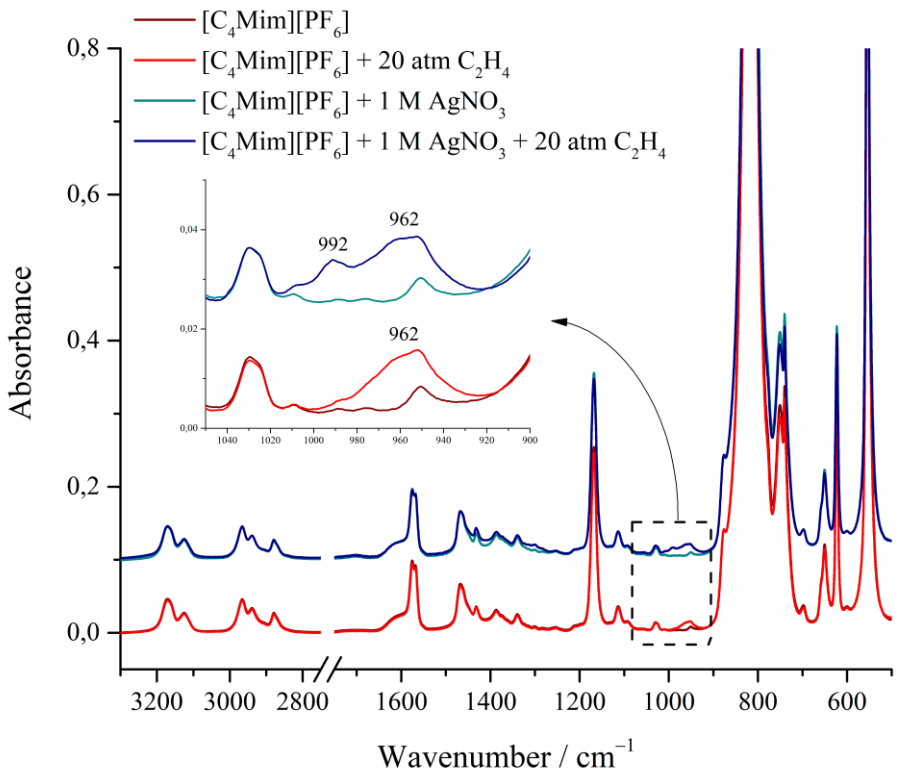

Figure S4 – ATR-FTIR spectra of $[C_4Mim][PF_6]$ IL at atmospheric pressure and ethylene pressure of 20 atm, including those with the addition of $AgNO_3$.

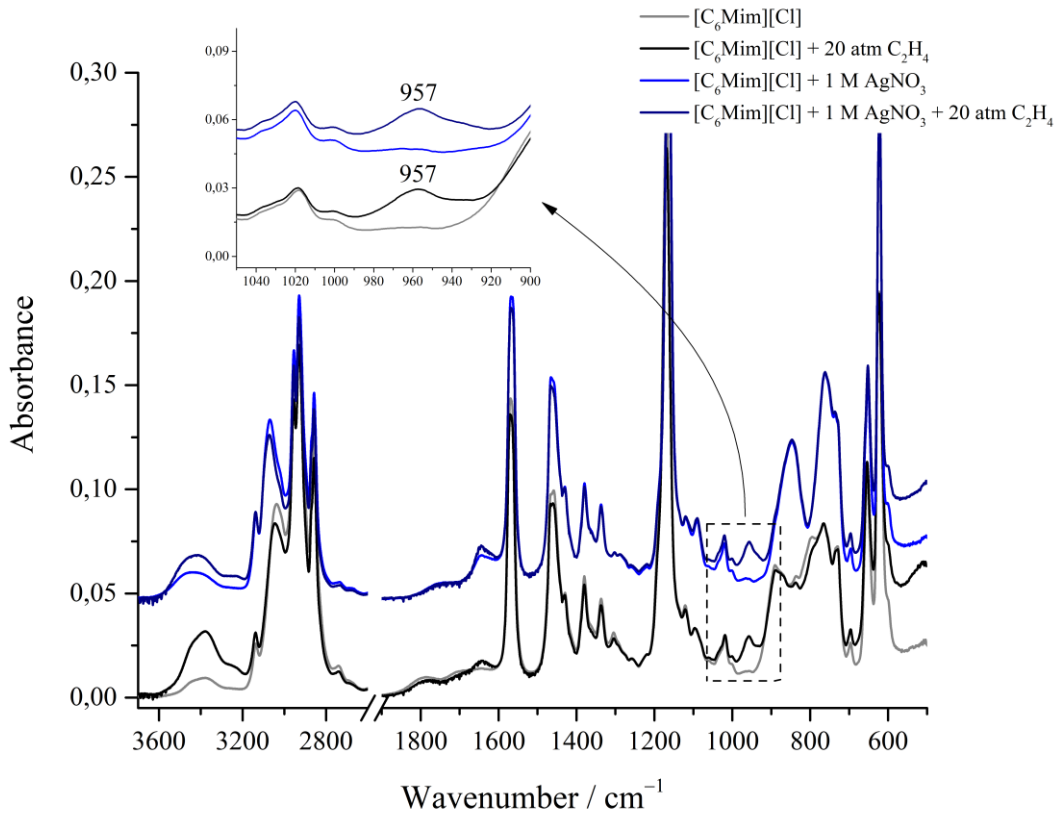

Figure S5 – ATR-FTIR spectra of [C_6Mim][Cl] IL at atmospheric pressure and ethylene pressure of 20 atm, including those with the addition of AgCl.

Table S2 - Stability constants of complex ions, the data taken from [2]

$$Ag^+ + iL^- \underset{\leftarrow}{\overset{\rightarrow}{}} AgL_i^{1-n} \; ; \; \beta_i = \frac{[AgL_i]^{1-i}}{[Ag^+][L^-]^i}$$

L	$lg\beta_1$	$lg\beta_2$	$lg\beta_3$	$lg\beta_4$
Cl^-	5,7	5,21	5,59	5,9
Br^-	4,38	8,53	8,7	8,78
OAc^-	0,74	–	–	–
NH_3	3,32	7,22	–	–
C_2H_4	1,35	–	–	–

References

S1. P. P. Korostelev, *Titrimetricheskii i gravimetricheskii analiz v metallurgii* (*Titrimetric and Gravimetric Analysis in Metallurgy*), Moscow, Metallurgiya, 1985 (in Russian).

S2. I. V. Pyatnitsky and V. V. Suhan, *Analiticheskaya khimiya serebra* (*Analytical Chemistry of Silver*), Nauka, Moscow, 1975 (in Russian).