

## Supporting Information

### Advanced palladium free approach to the synthesis of substituted alkene oxindoles via aluminum-promoted Knoevenagel reaction

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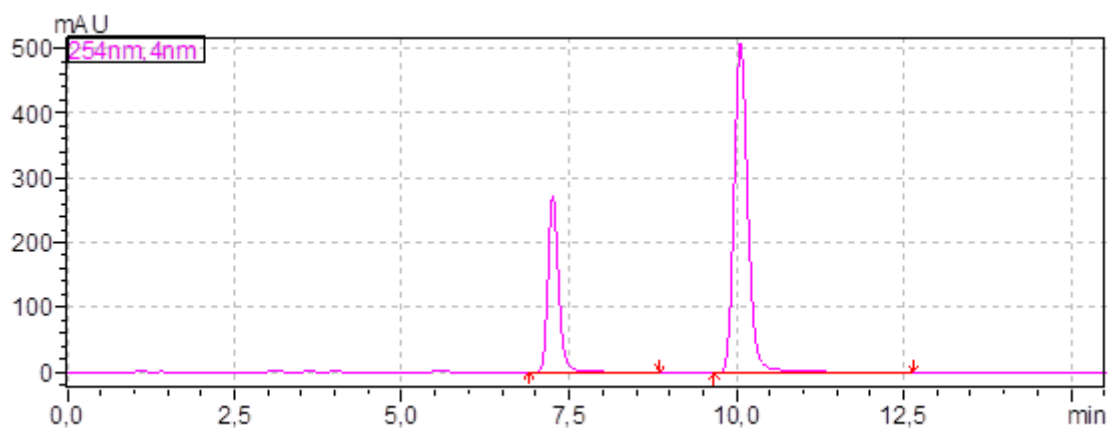
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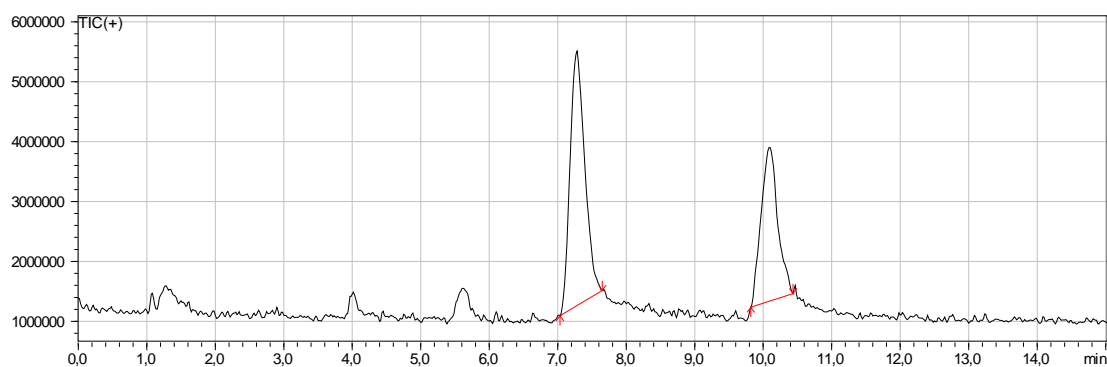
## Product mixture analysis

The product mixture of (*E*)-3-((3-((4-chlorophenyl)(phenyl)methylene)-2-oxoindolin-1-yl)methyl)benzoic acid methyl ester (C24 methyl ester) and its dehalogenated form, obtained after the ring formation reaction and purification by flash chromatography in the hexane-ethyl acetate system (9:1), was further crystallized and analyzed. It should be noted, that the compounds have the same retention times on normal-phase silica gel, thus can be separated only on reversed-phase silica gel.

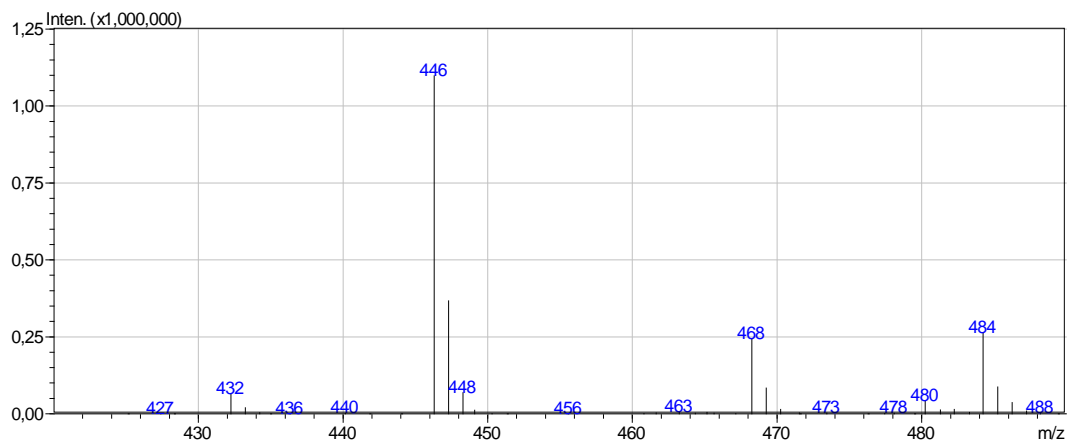
**LCMS data.** LCMS analysis was performed using a Nucleodur PolarTec column (Macherey-Nagel), length 150 mm, internal diameter 3.0 mm, particle size 3  $\mu\text{m}$ , in the system of acetonitrile–0.5% trifluoroacetic acid (70/30), flow rate 0.4 mL/min.



Peak#	Ret. Time	Area%
1	7.257	29.154
2	10.062	70.846
Total		100.000



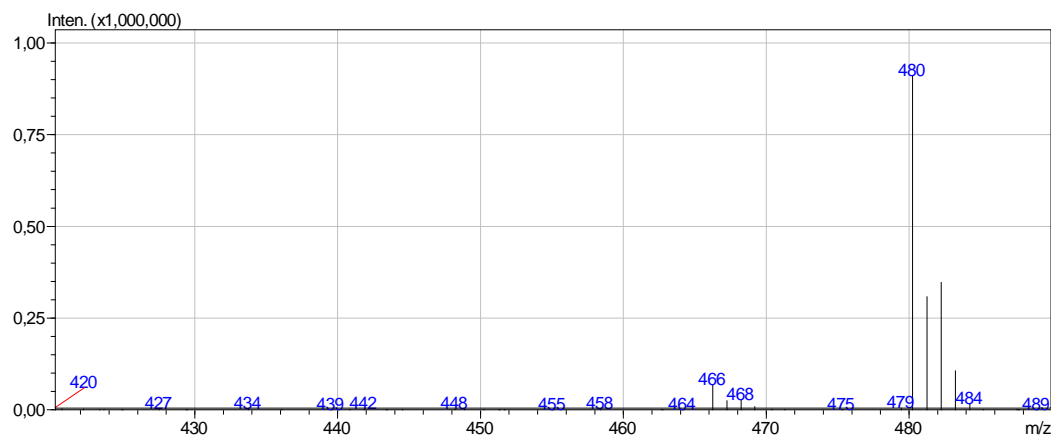
Mass spectrum of the first peak (corresponds to the dehalogenated product):



Raw Spectrum: [7.100 → 7.533]; Background: [6.883 → 7.083]; Base Peak: m/z 446.30

Peak#	m/z	Absolute Intensity	Relative Intensity
1	446.30	1097703	100.00
2	447.30	367165	33.45
3	484.25	261138	23.79
4	468.25	243512	22.18
5	485.25	87042	7.93
6	469.25	83168	7.58
7	448.30	68476	6.24

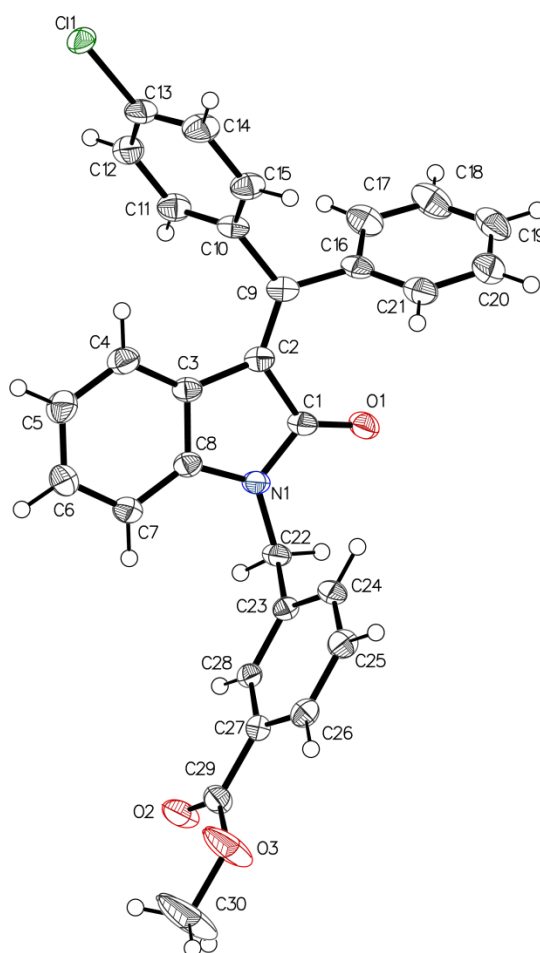
Mass spectrum of the second peak (corresponds to the target product, C24 methyl ester):



Raw Spectrum: [9.867 → 10.283]; Background: [9.650 → 9.817]; Base Peak: m/z 480.25

Peak#	m/z	Absolute Intensity	Relative Intensity
1	480.25	911034	100.00
2	482.25	346857	38.07
3	481.25	308090	33.82
4	483.25	105977	11.63
5	466.25	68287	7.50
6	468.25	25593	2.81
7	467.25	23988	2.63

**Crystal data** for  $C_{30}H_{22.25}Cl_{0.75}NO_3$  ( $M = 471.35$  g/mol): triclinic, space group  $P-1$  (no. 2),  $a = 10.2260(7)$  Å,  $b = 10.6156(8)$  Å,  $c = 11.7663(8)$  Å,  $\alpha = 69.018(7)^\circ$ ,  $\beta = 85.368(6)^\circ$ ,  $\gamma = 85.951(6)^\circ$ ,  $V = 1187.51(15)$  Å<sup>3</sup>,  $Z = 2$ ,  $T = 100(2)$  K,  $\mu(\text{MoK}\alpha) = 0.166$  mm<sup>-1</sup>,  $D_{\text{calc}} = 1.318$  g/cm<sup>3</sup>, 17805 reflections measured ( $5.608^\circ \leq 2\theta \leq 53.998^\circ$ ), 5168 unique ( $R_{\text{int}} = 0.0260$ ,  $R_{\text{sigma}} = 0.0239$ ) which were used in all calculations. The final  $R_1$  was 0.0470 ( $I > 2\sigma(I)$ ) and  $wR_2$  was 0.1196 (all data).



**Experimental procedure.** The single crystal of  $C_{30}H_{22.25}Cl_{0.75}NO_3$  was immersed in cryo-oil, mounted in a Nylon loop, and measured at 100 K on a Xcalibur Eos diffractometer equipped with a flat CCD detector. Using Olex2,<sup>1</sup> the structure was solved with the ShelXT structure solution program using Intrinsic Phasing and refined with the ShelXL refinement package using Least Squares minimization.<sup>2,3</sup> The absorption correction was applied in the CrysAlisPro software package (Agilent Technologies, version 1.171.36.20) empirically, using the spherical harmonics implemented in the SCALE3 ABSPACK scaling algorithm. Hydrogen atoms were included in the refinement with fixed positional and temperature parameters (in the `riding` model approximation according to the SHELX algorithms), with C-H = 0.93-0.97 Å, and  $U_{\text{iso}}(\text{H}) = 1.2-1.5U_{\text{eq}}(\text{C})$ .

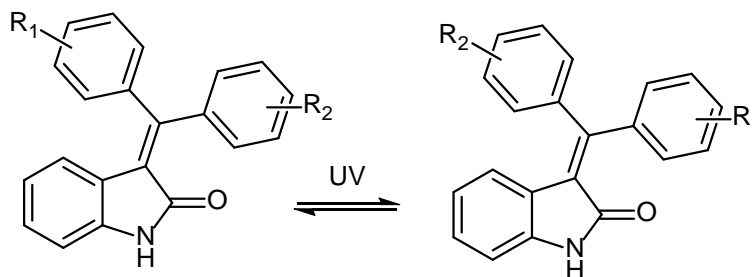
The CIF file containing the structural information have been deposited in CCDC No 1585543, and is available in the database of organic compound crystal structures at the site [www.ccdc.cam.ac.uk/data\\_request/cif](http://www.ccdc.cam.ac.uk/data_request/cif).

It is worth noting that the Cl1 position is only partially occupied. The site scattering of Cl1 position is 12.75 epfu (electron per formula unit) that corresponds to 0.75 apfu (atoms per formula unit) of chlorine. Thus we observe two types of molecules in the crystal structure: C<sub>30</sub>H<sub>22</sub>ClNO<sub>3</sub> and its dehalogenated C<sub>30</sub>H<sub>23</sub>NO<sub>3</sub> form with the ratio 0.75 to 0.25, respectively.

## References

- (1) Dolomanov, O. V.; Bourhis, L. J.; Gildea, R. J, Howard, J. A. K.; Puschmann, H. *J. Appl. Cryst.* **2009**, *42*, 339.
- (2) Sheldrick, G. M. *Acta Cryst.* **2015**, *A71*, 3.
- (3) Sheldrick, G.M. *Acta Cryst.* **2015**, *C71*, 3.

## *E/Z* isomerization



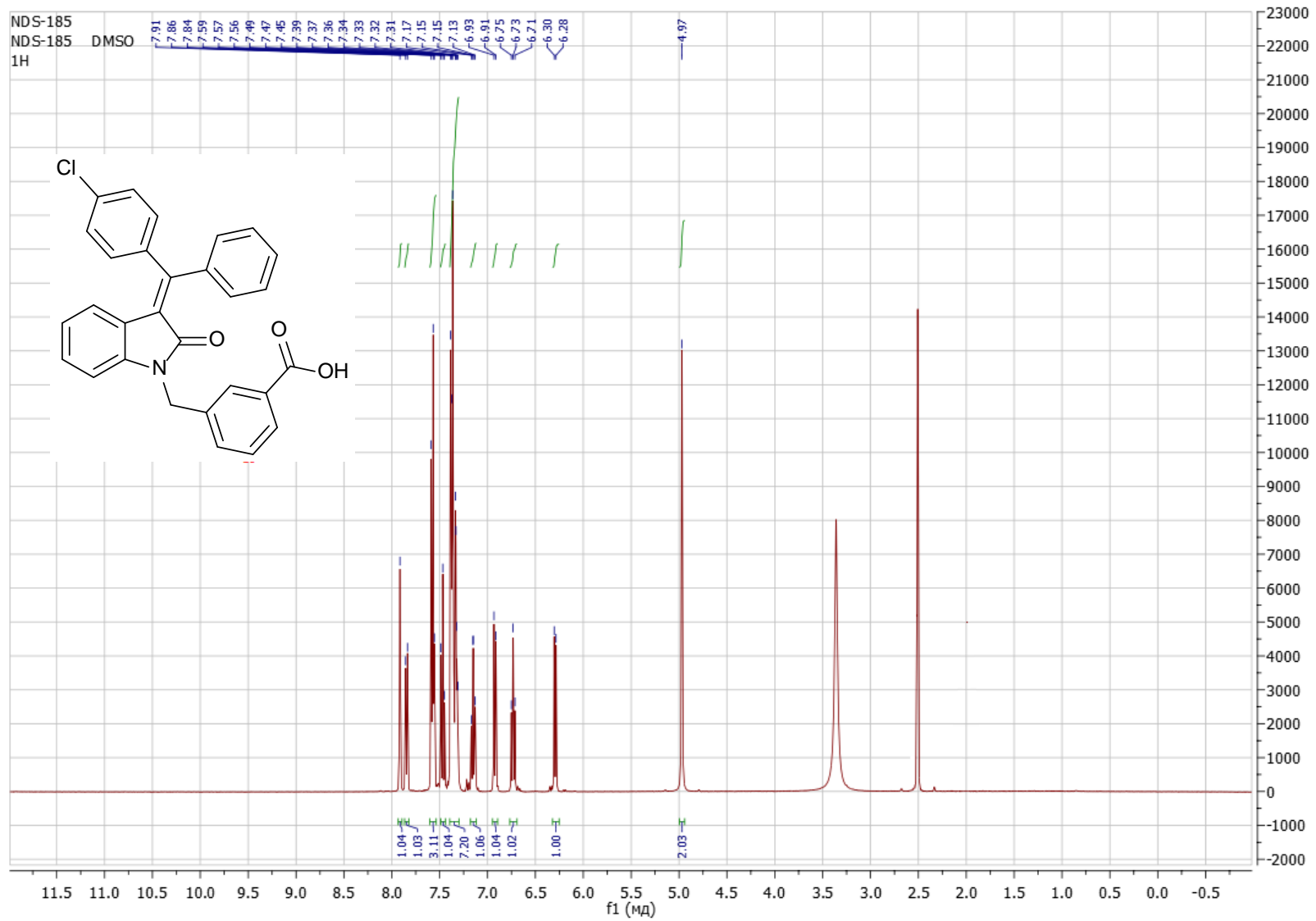
**General procedure for UV-driven isomerization** of unsymmetrically substituted alkene oxindole compounds.

Alkene oxindole (0.01 mol) was placed into round bottom flask, supplemented with magnetic stirrer and reflux condenser, and dissolved in 150 mL of methanol. The reaction mixture was irradiated with high-power mercury lamp (1000 W). The reaction was monitored by HPLC until the *E/Z* ratio ceased to change (usually 5-20 min). Then the mixture was cooled, the solvent was evaporated under reduced pressure. The residue represented by the pure mixture of *E*- and *Z*-isomer was applied on silica gel and separated by flash chromatography (n-hexane/ethyl acetate).

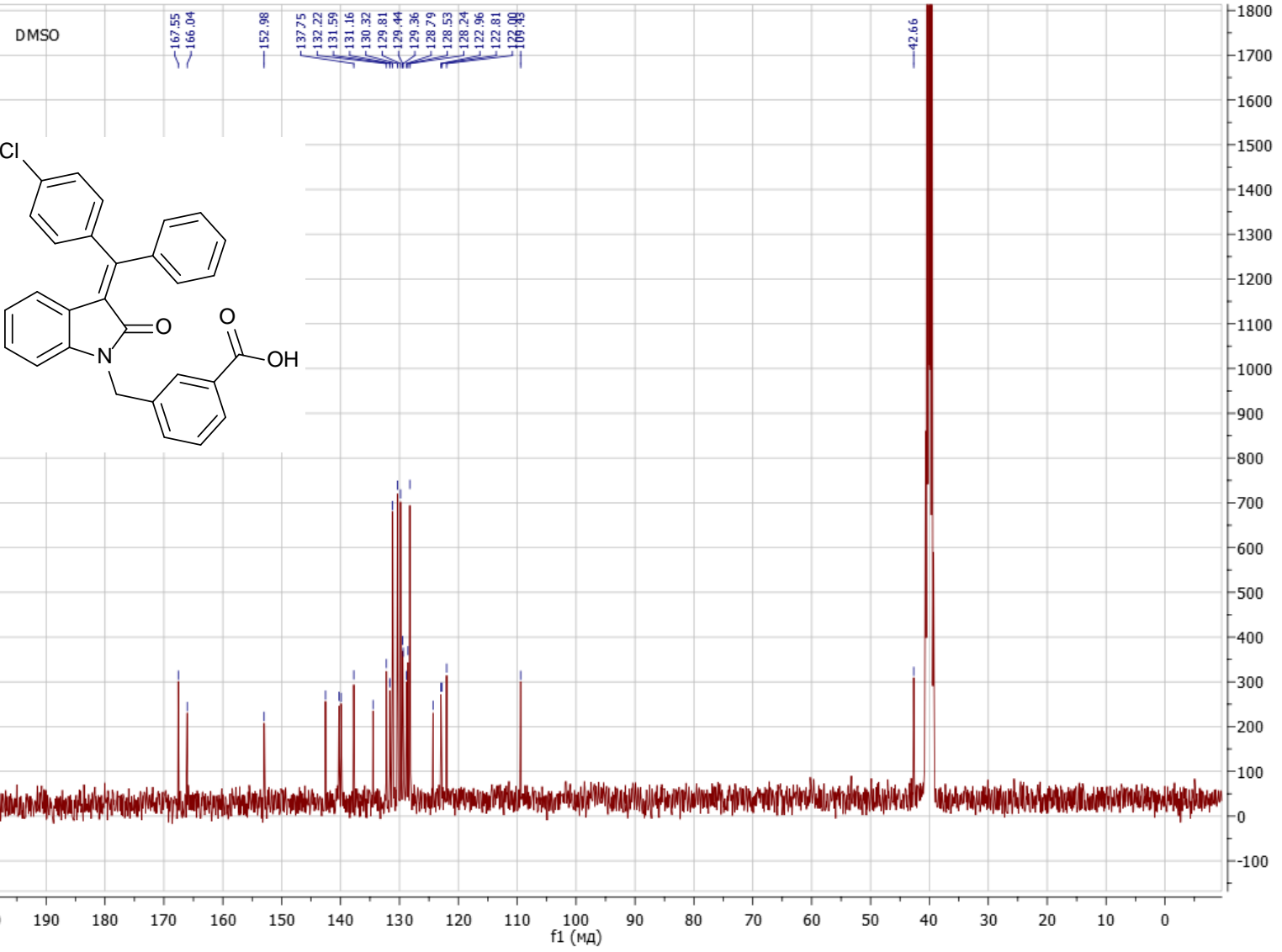
If no high-power UV source is available, it is possible to use the natural UV source. For this, alkene oxindole is dissolved in the same amount of methanol and exposed to daylight. In this case, the isomerization reaction can take up to several days.

# NMR spectra

*(E)*-3-((3-((4-chlorophenyl)(phenyl)methylene)-2-oxindolin-1-yl)methyl)benzoic acid (C24)

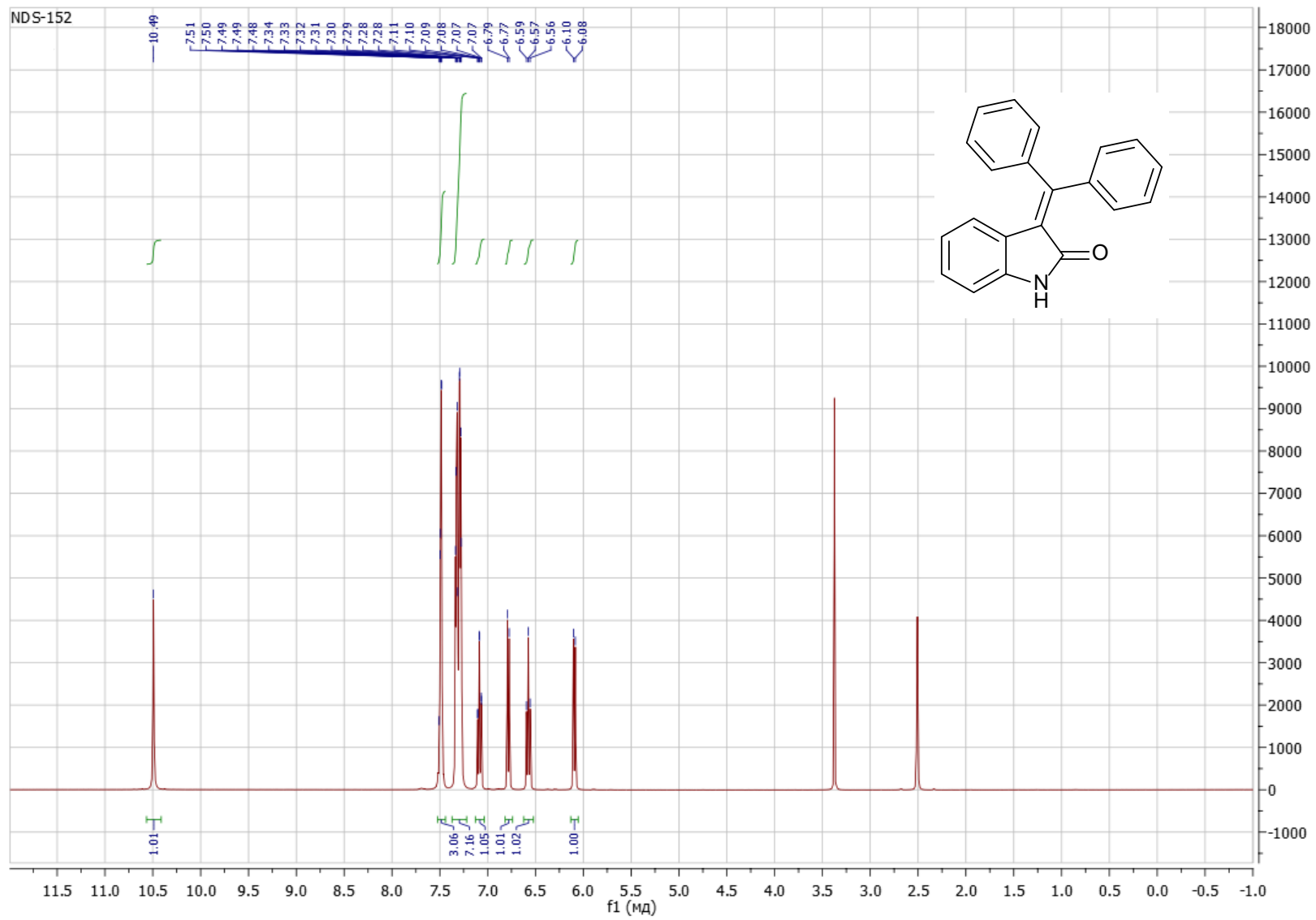


NDS-185  
NDS-185  
13C

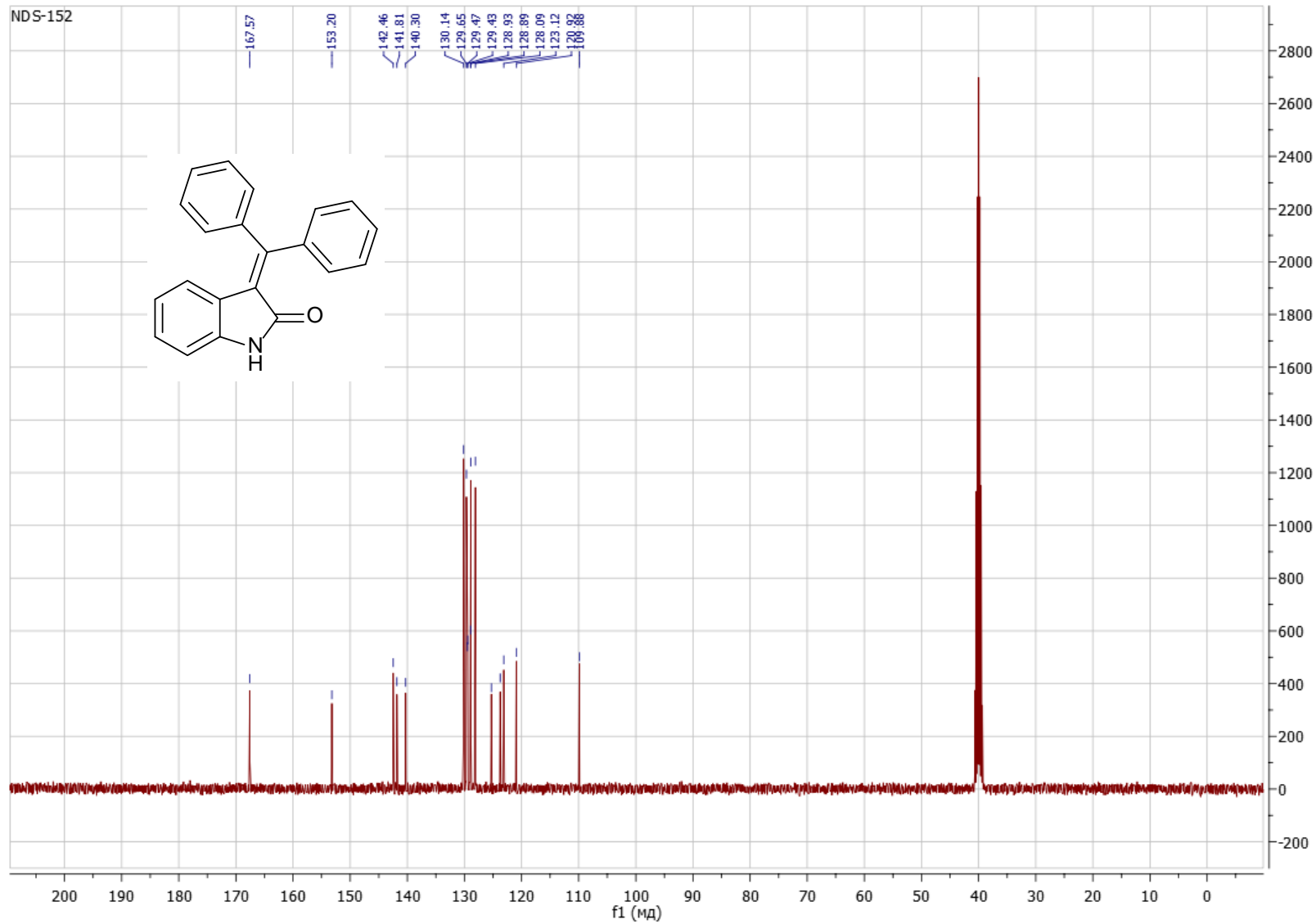
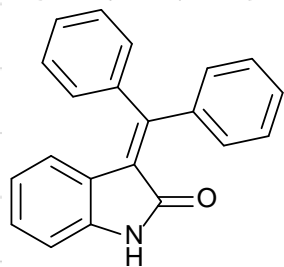




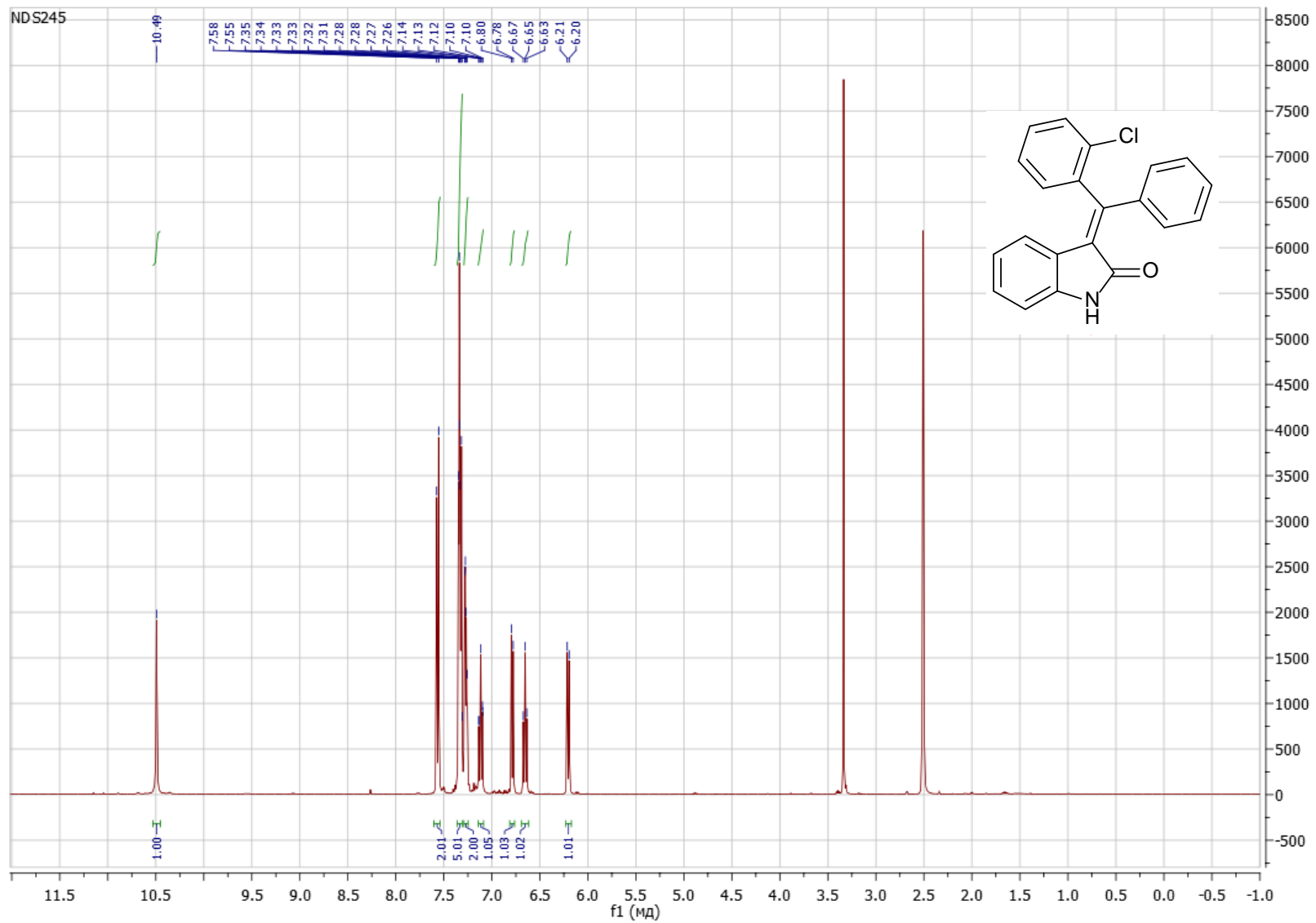
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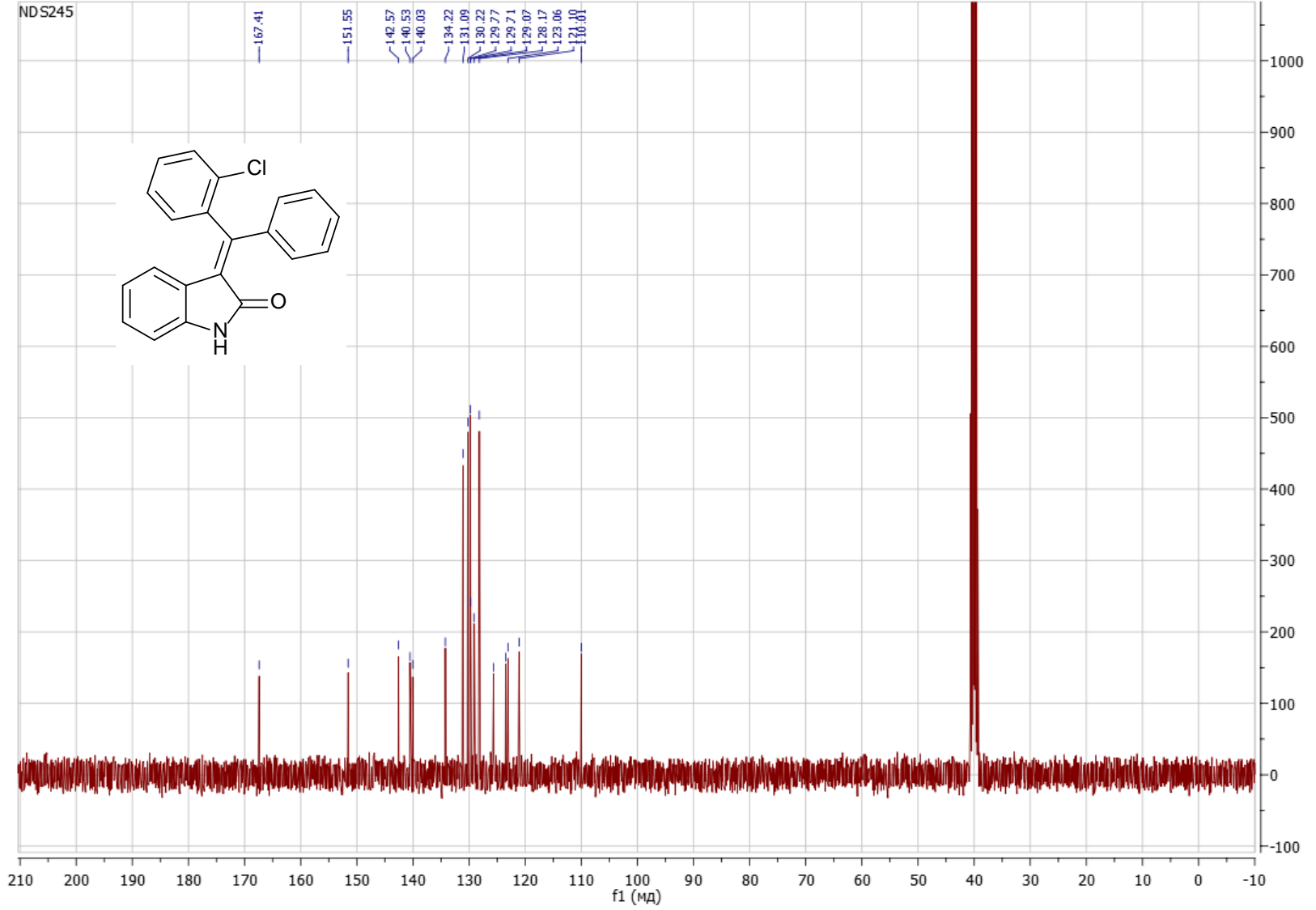
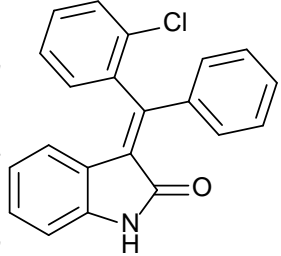
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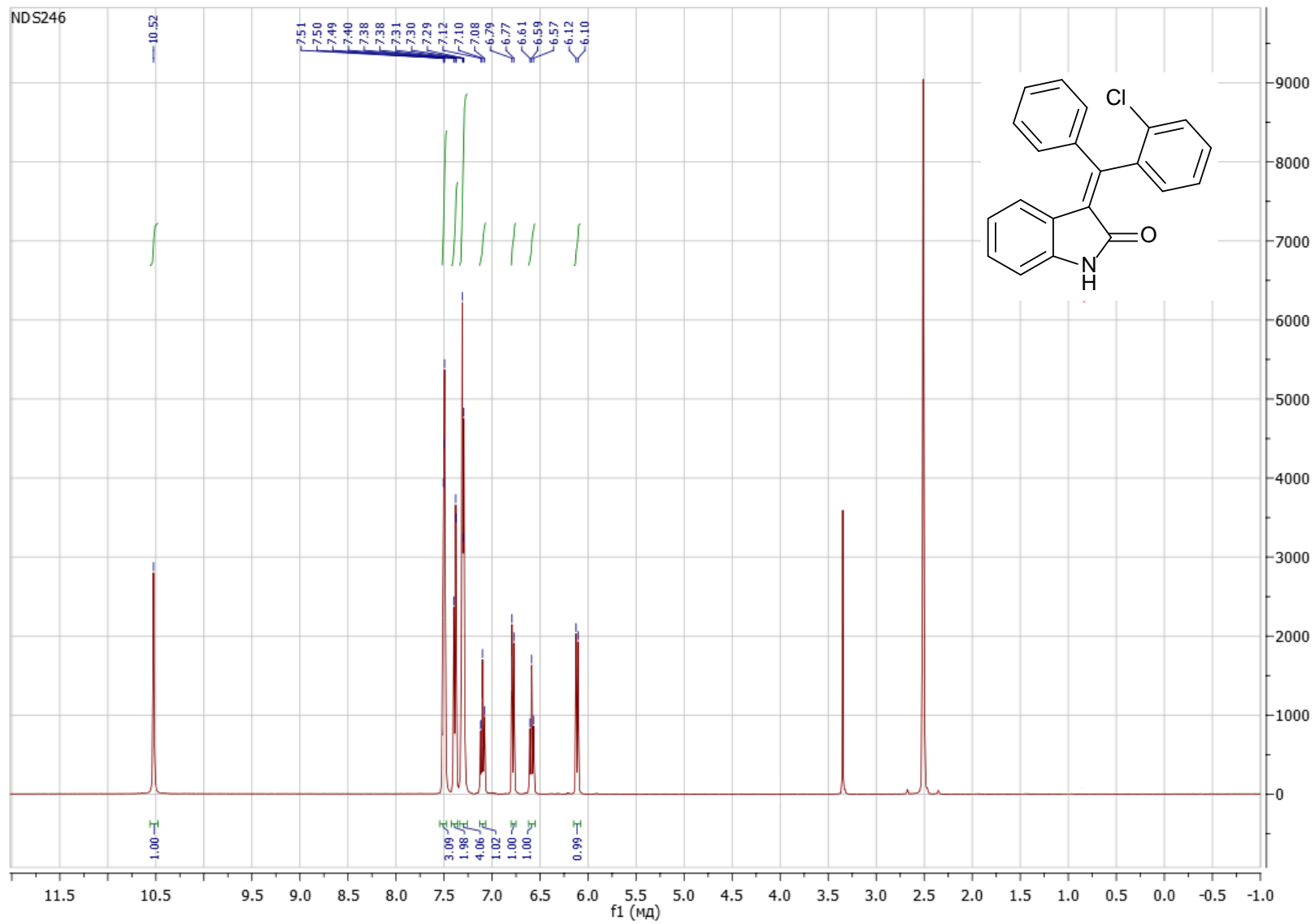
*(E)*-3-((2-chlorophenyl)(phenyl)methylene)indolin-2-one



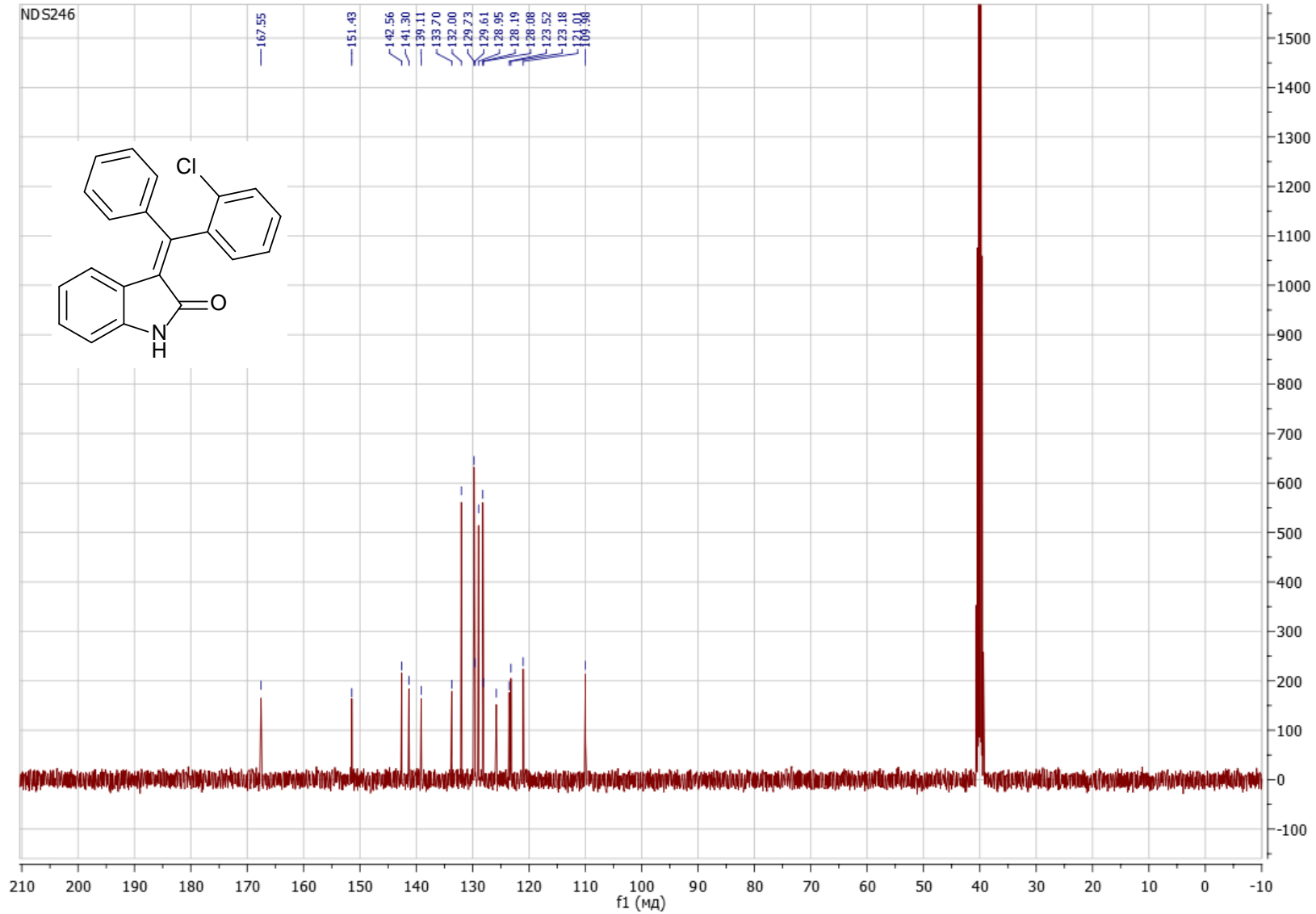
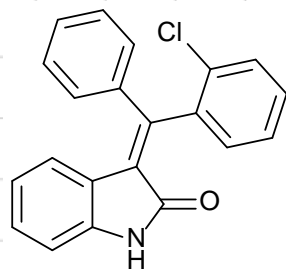
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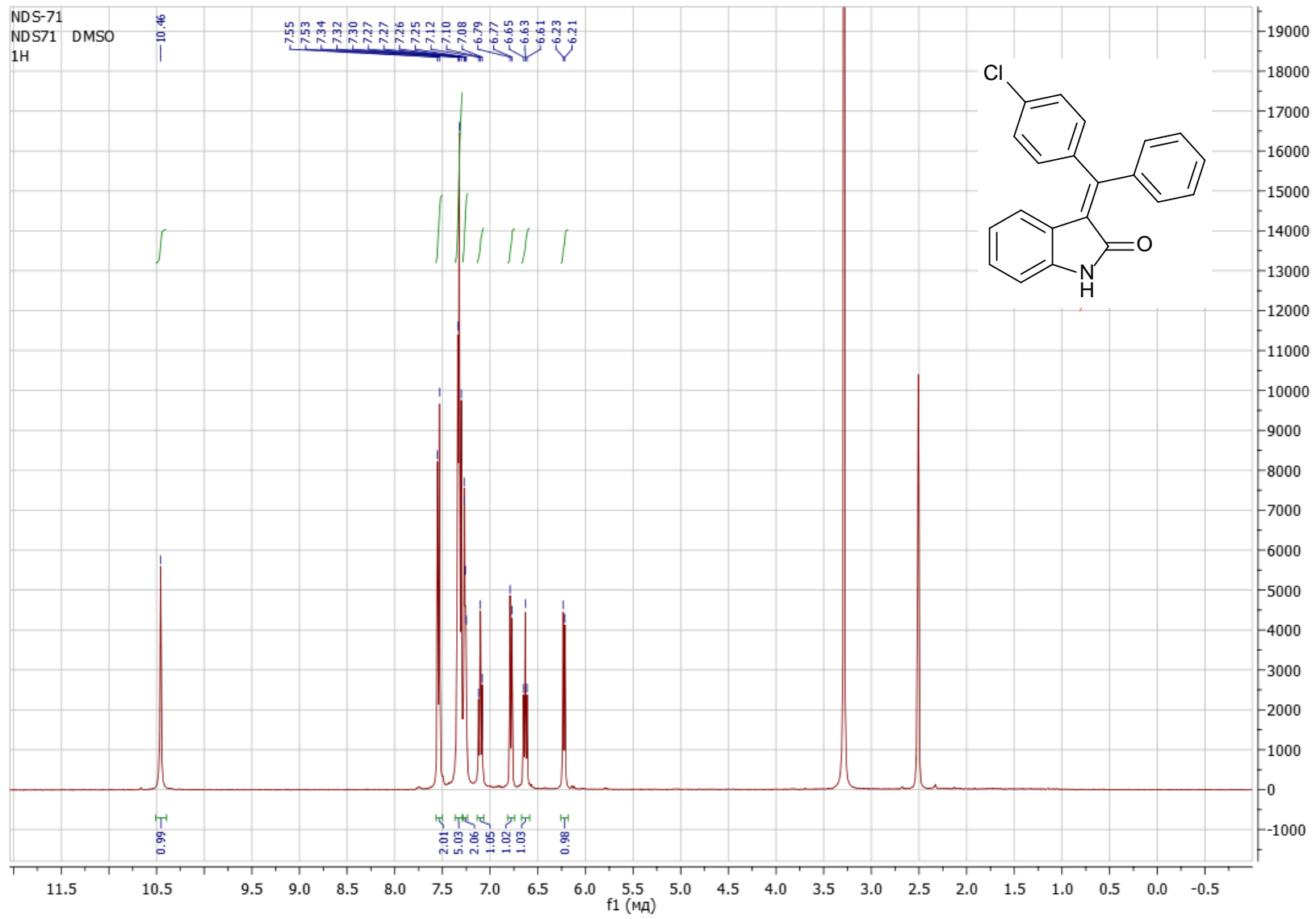
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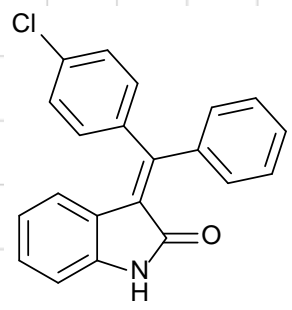
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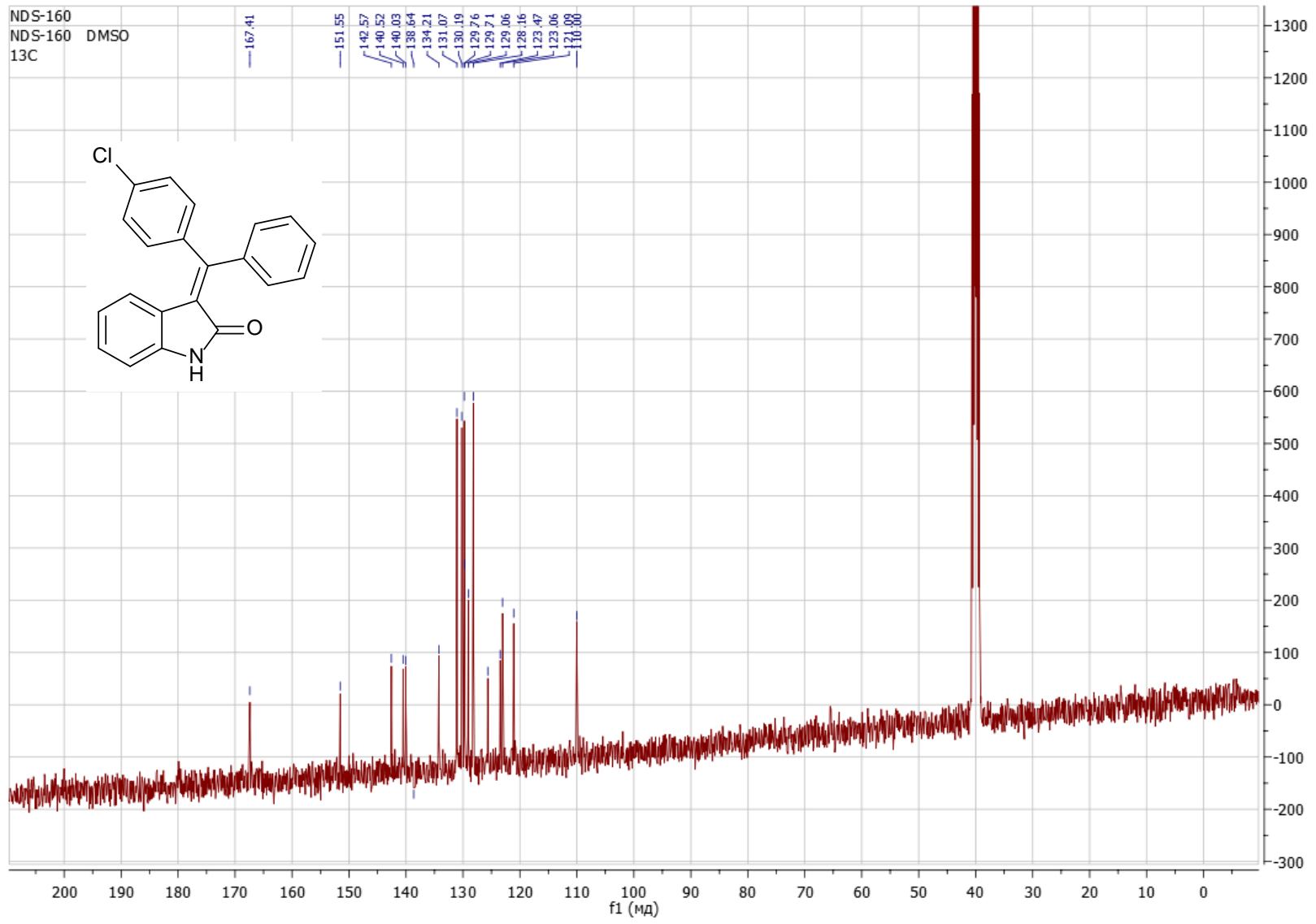
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NDS-160  
NDS-160 DMSO  
13C

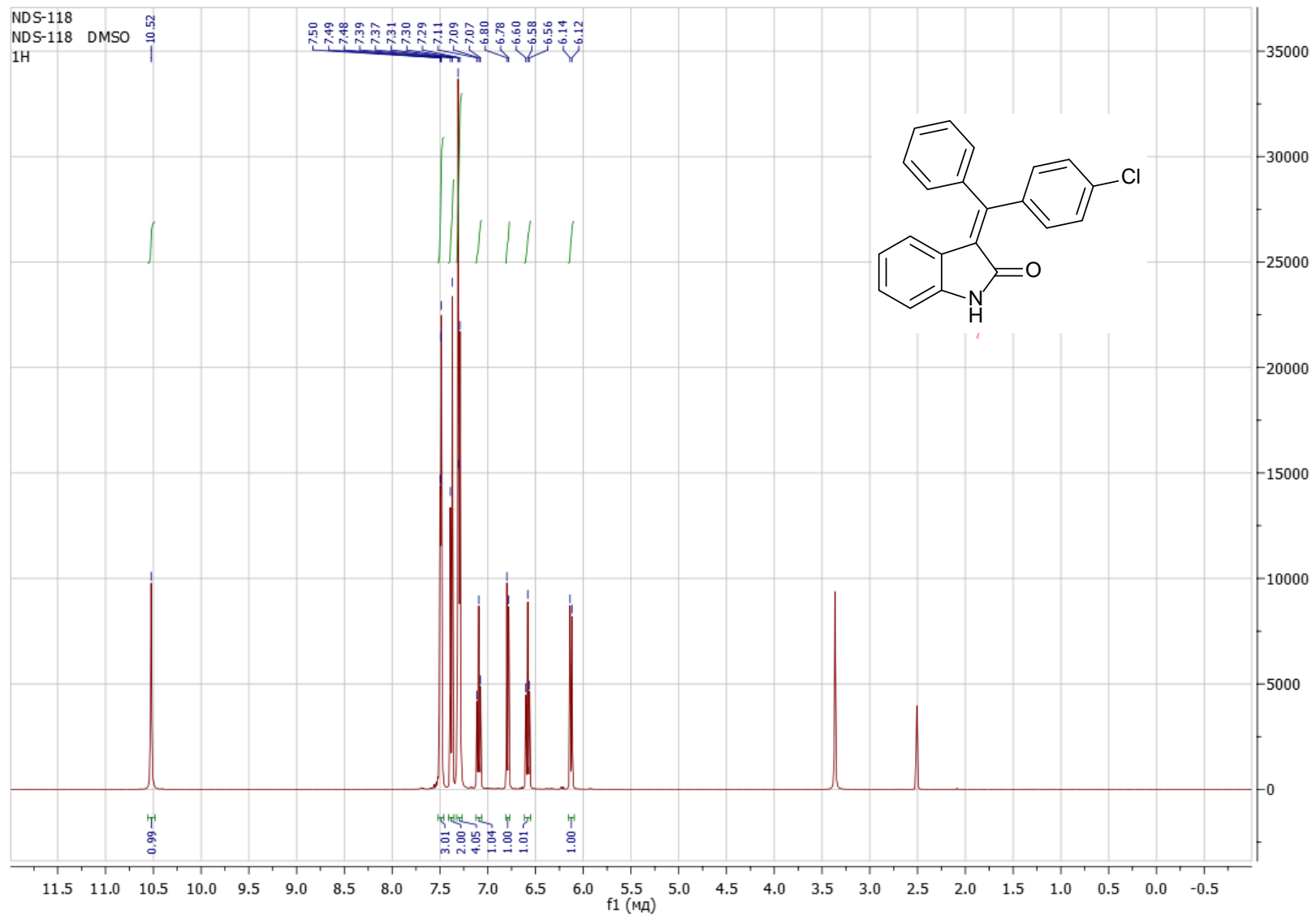


- 167.41
- 151.55
- 142.57
- 140.52
- 140.03
- 138.64
- 134.21
- 131.07
- 130.19
- 129.76
- 129.71
- 129.06
- 128.16
- 123.47
- 123.06
- 121.08
- 110.00



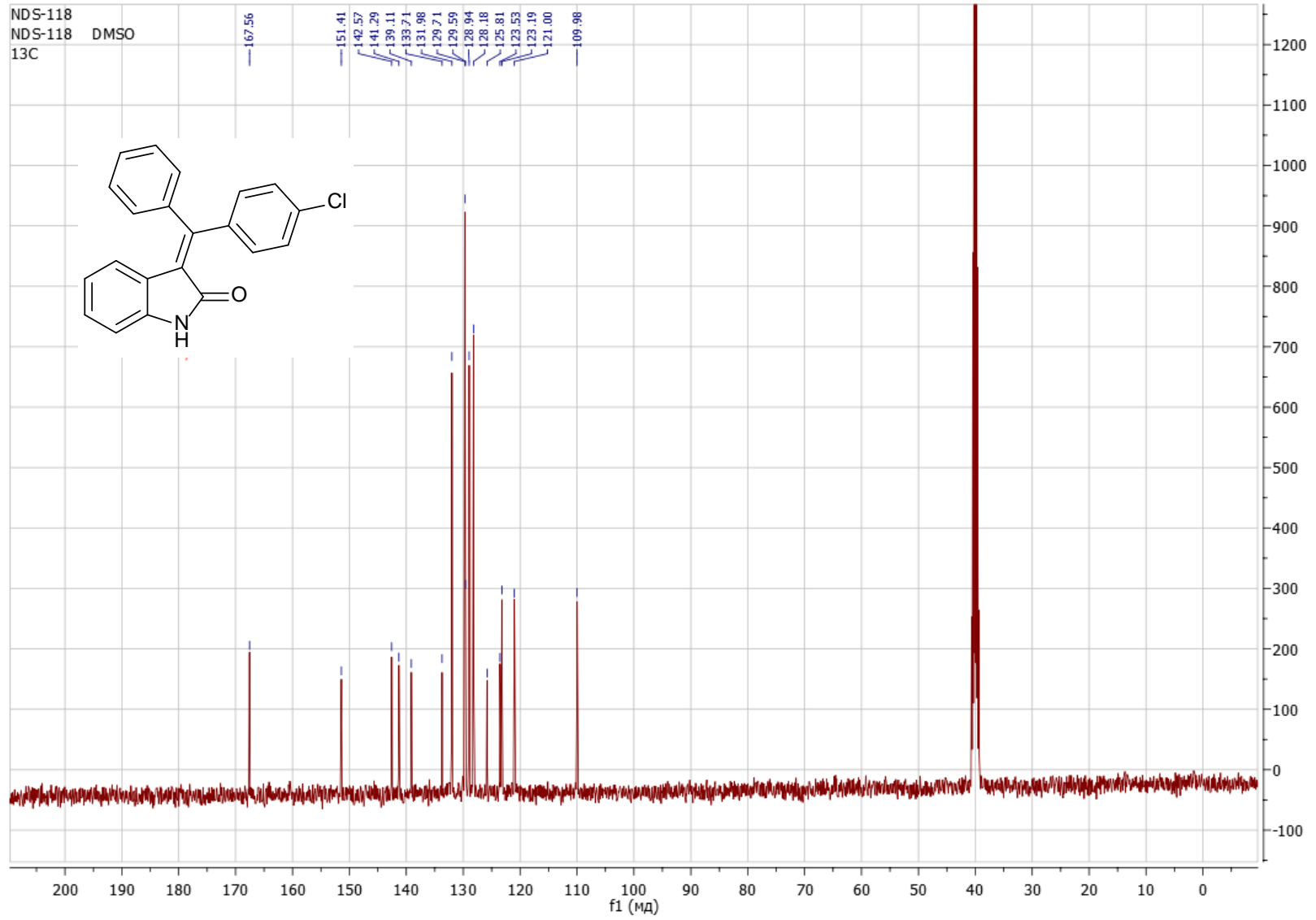
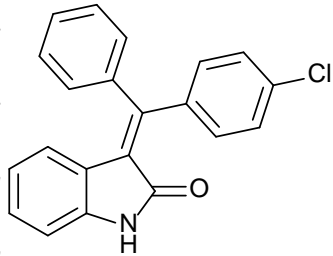


*(Z)*-3-((4-chlorophenyl)(phenyl)methylene)indolin-2-one

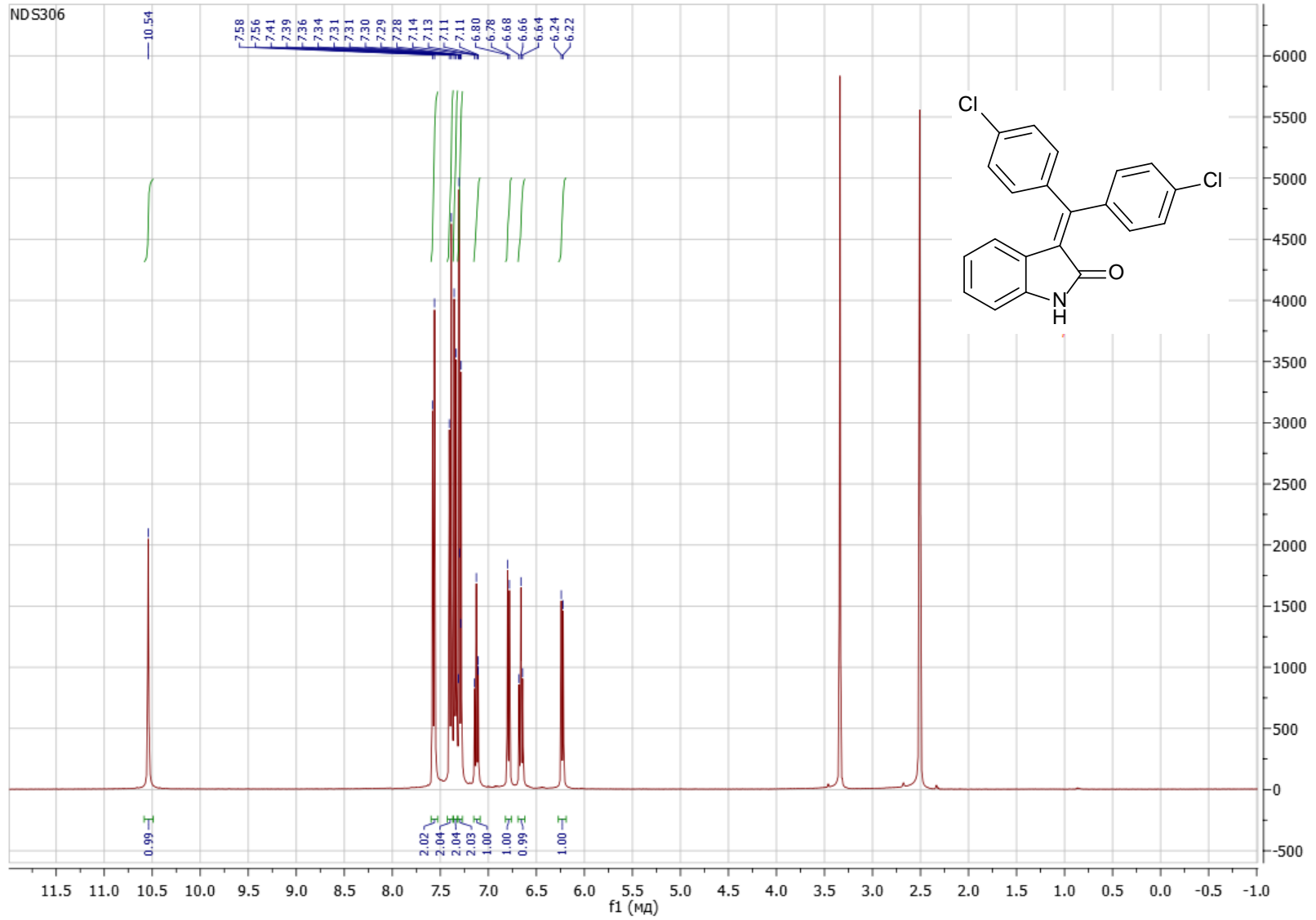


NDS-118  
NDS-118  
13C

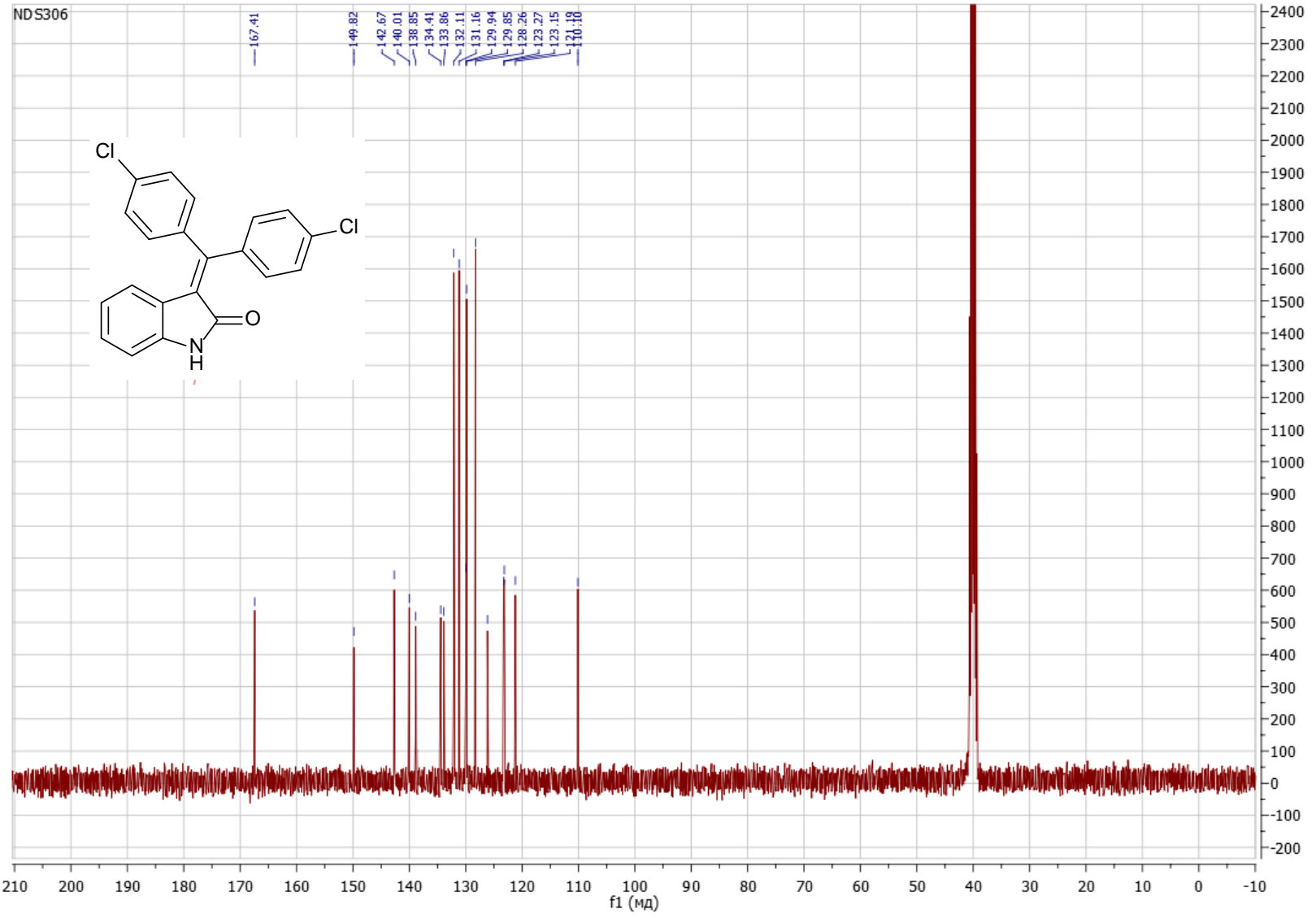
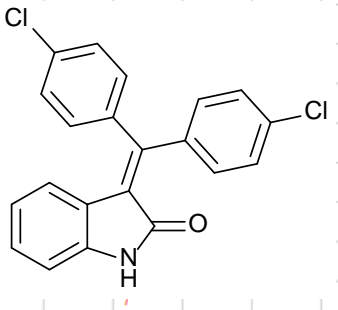
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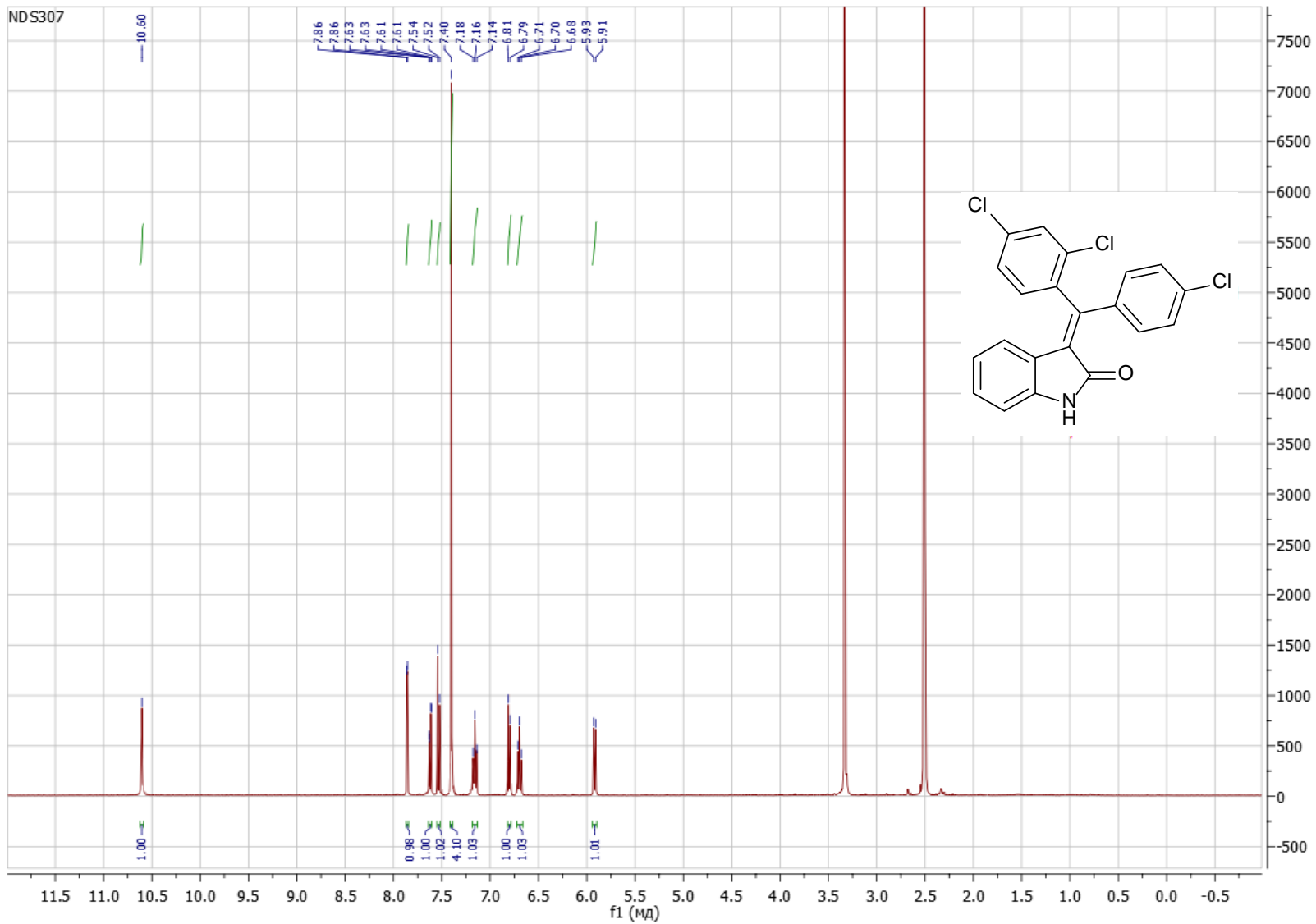
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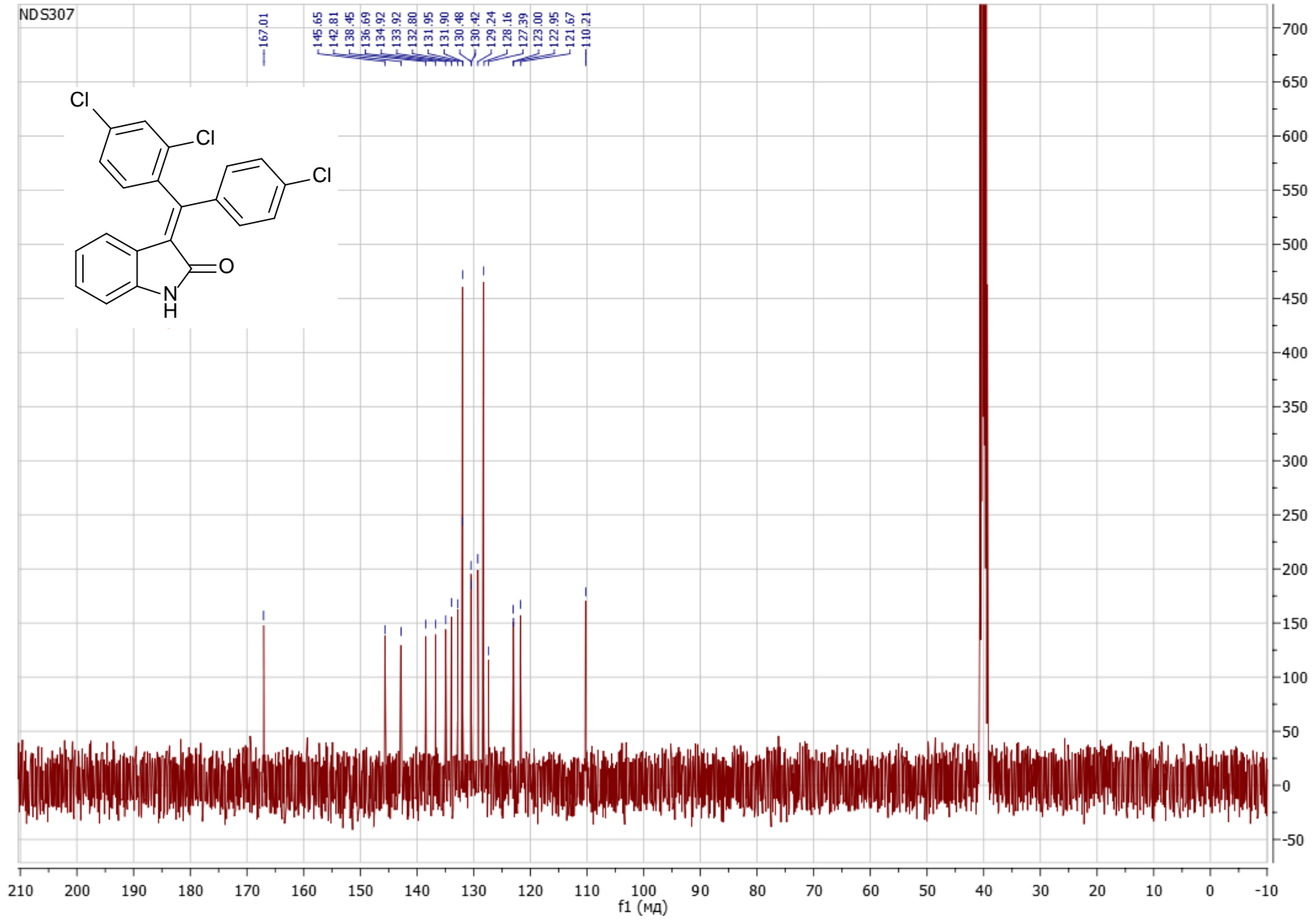


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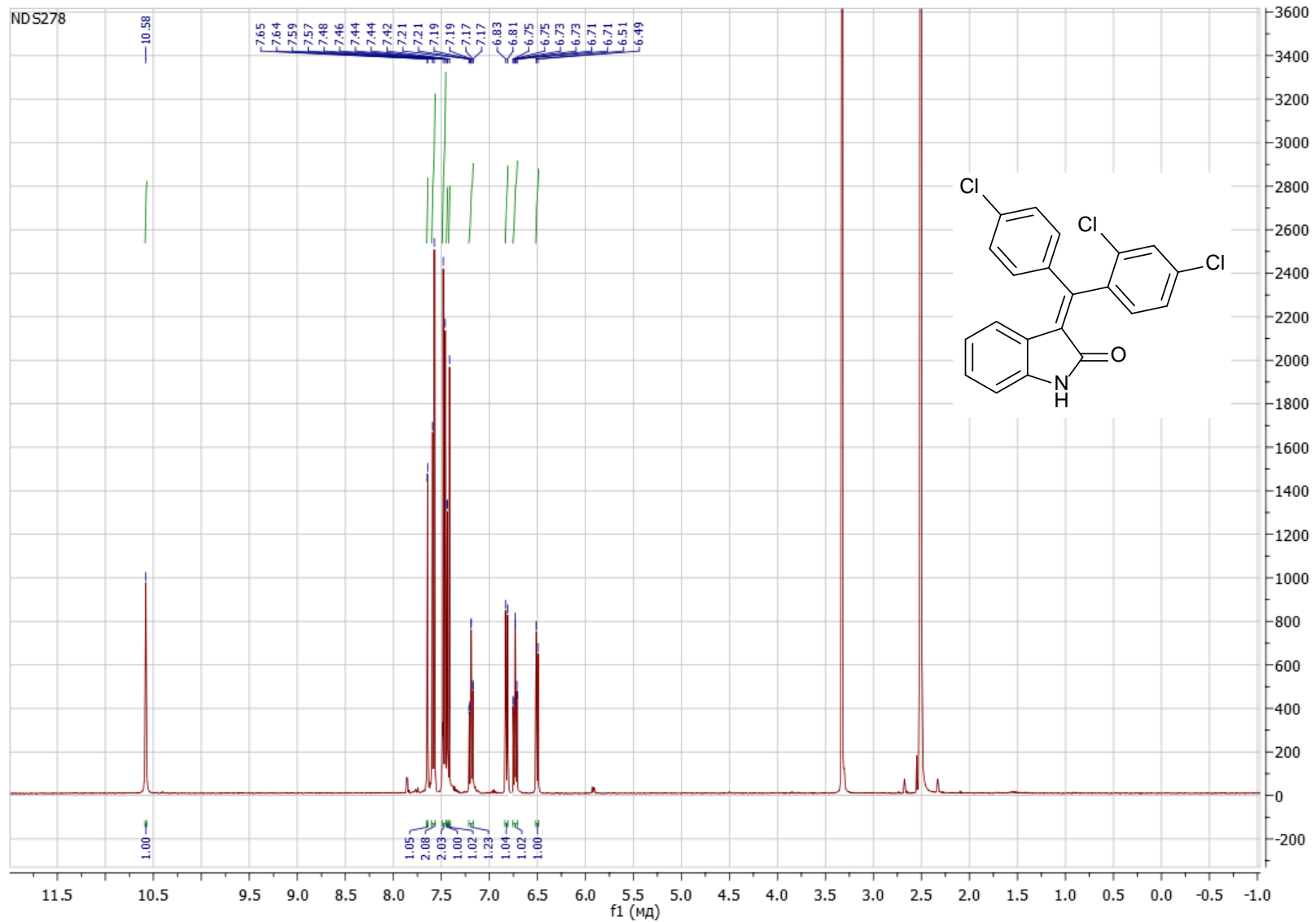


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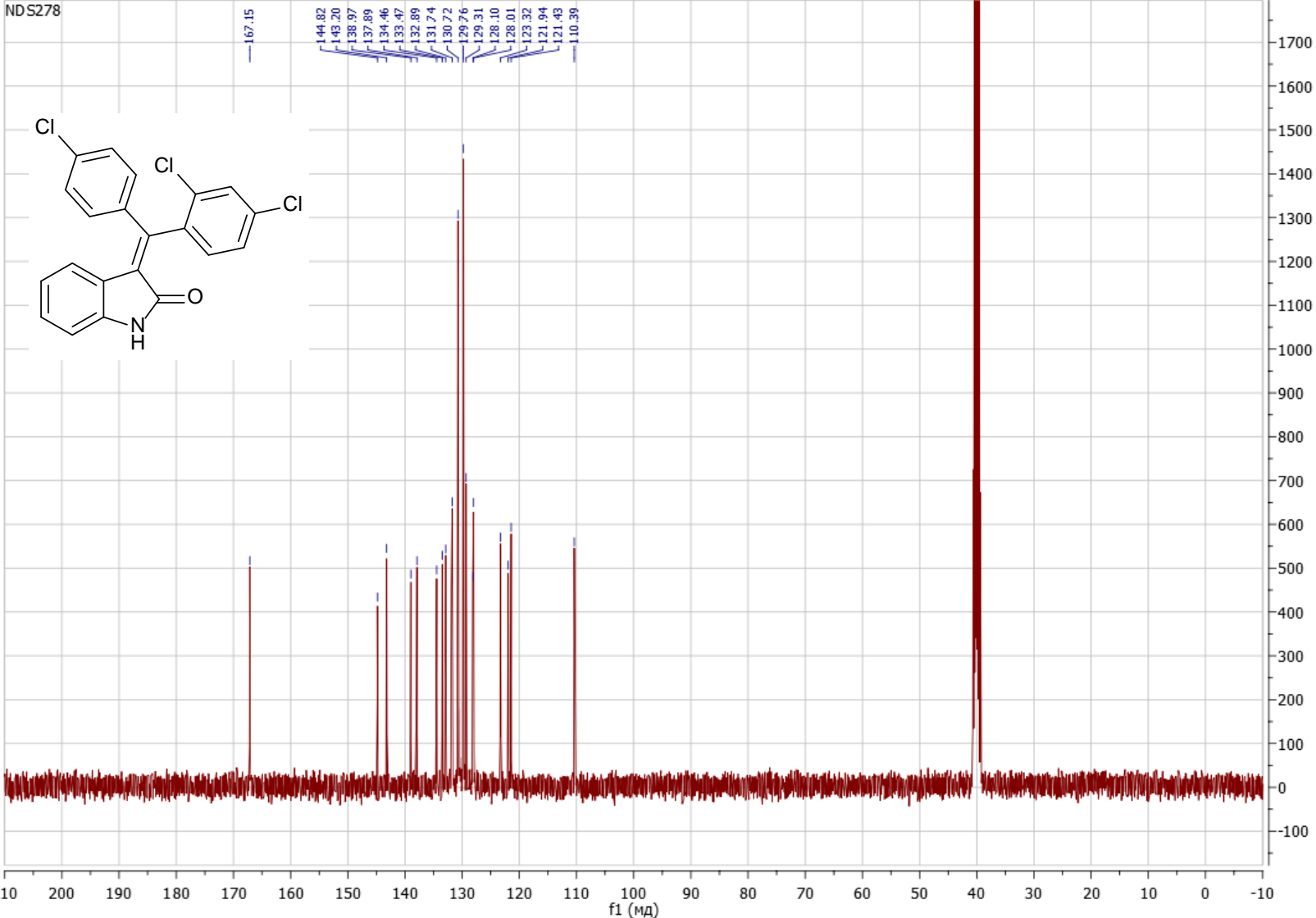




*(Z)-3-((4-chlorophenyl)(2,4-dichlorophenyl)methylene)indolin-2-one*

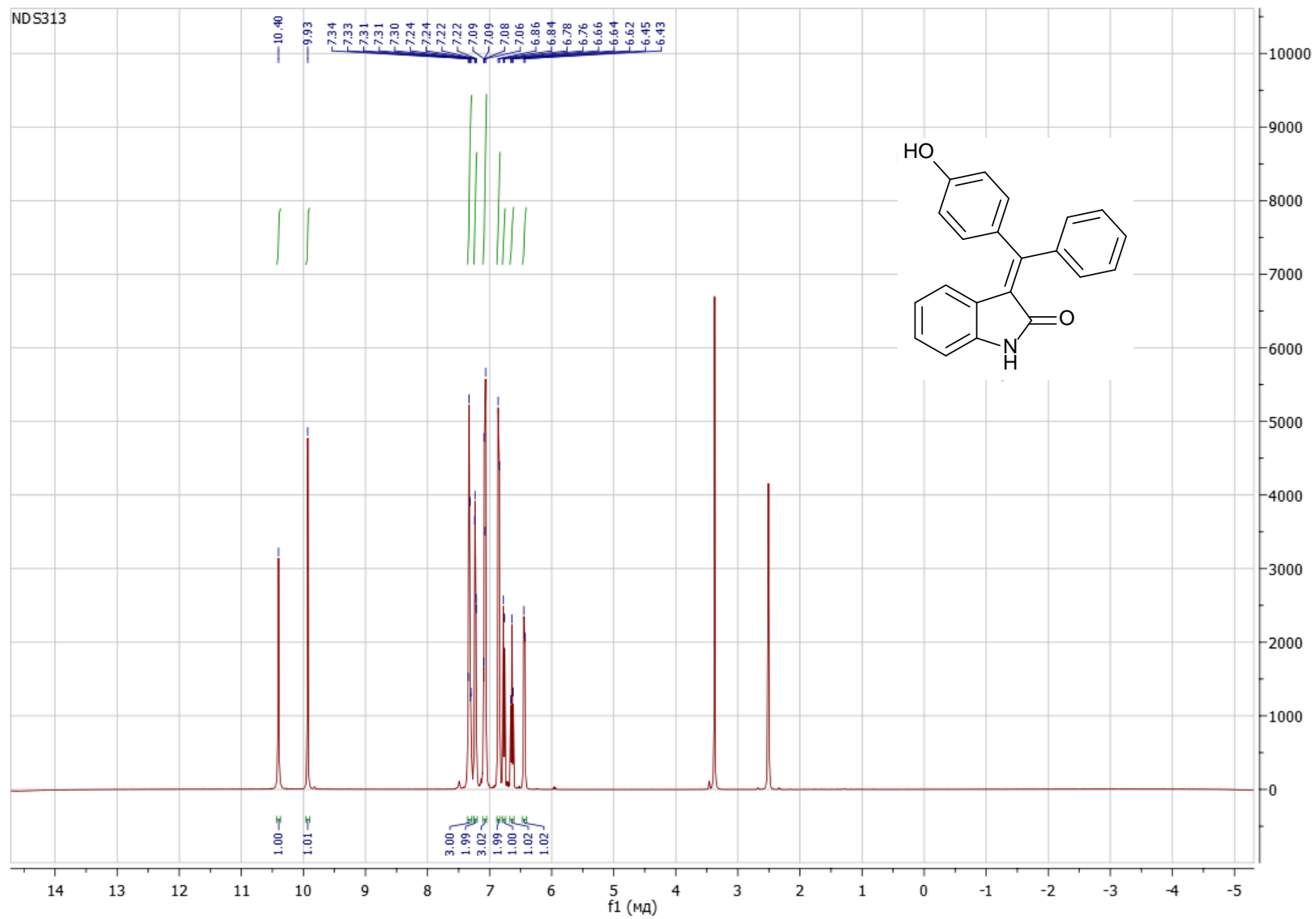


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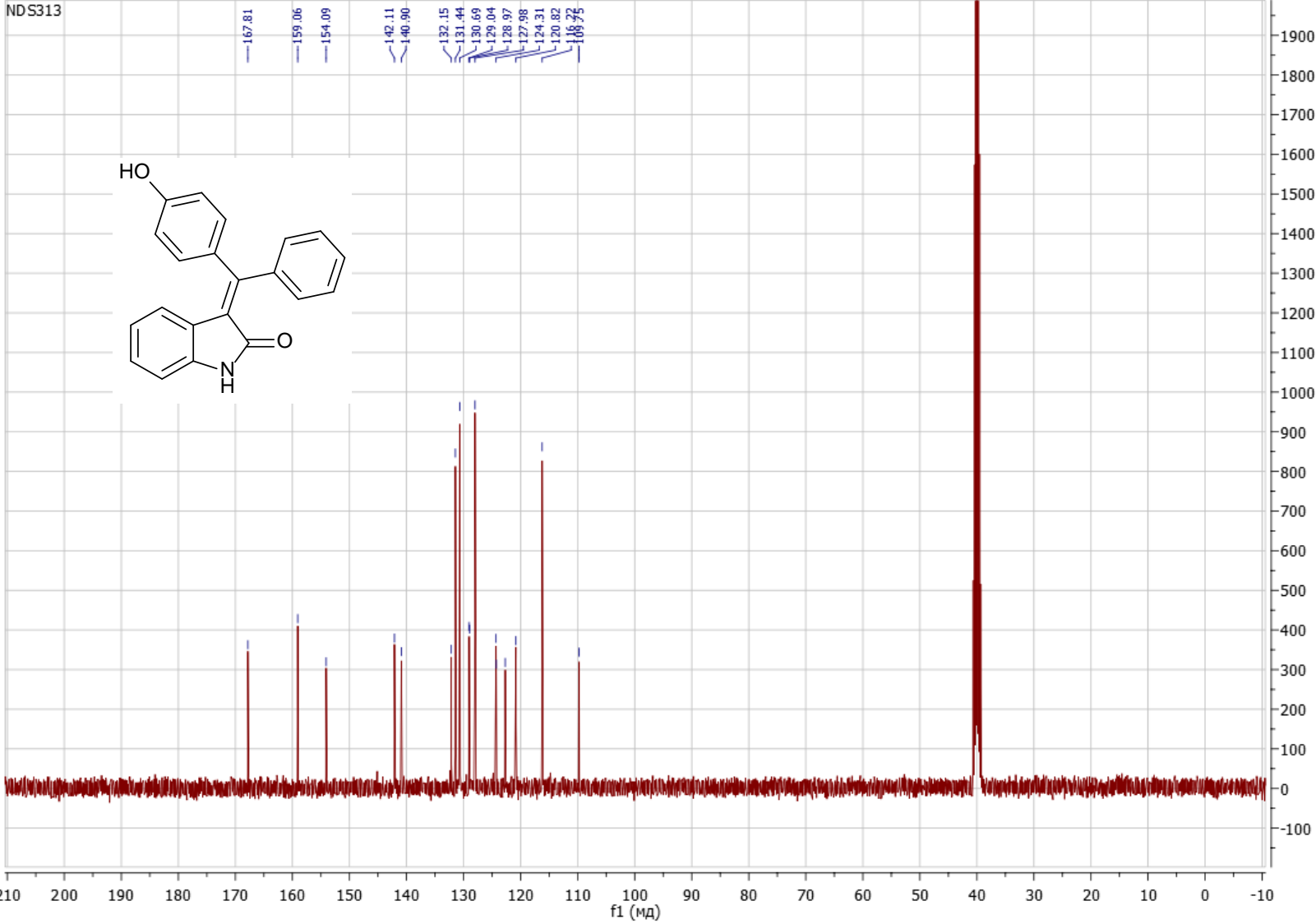




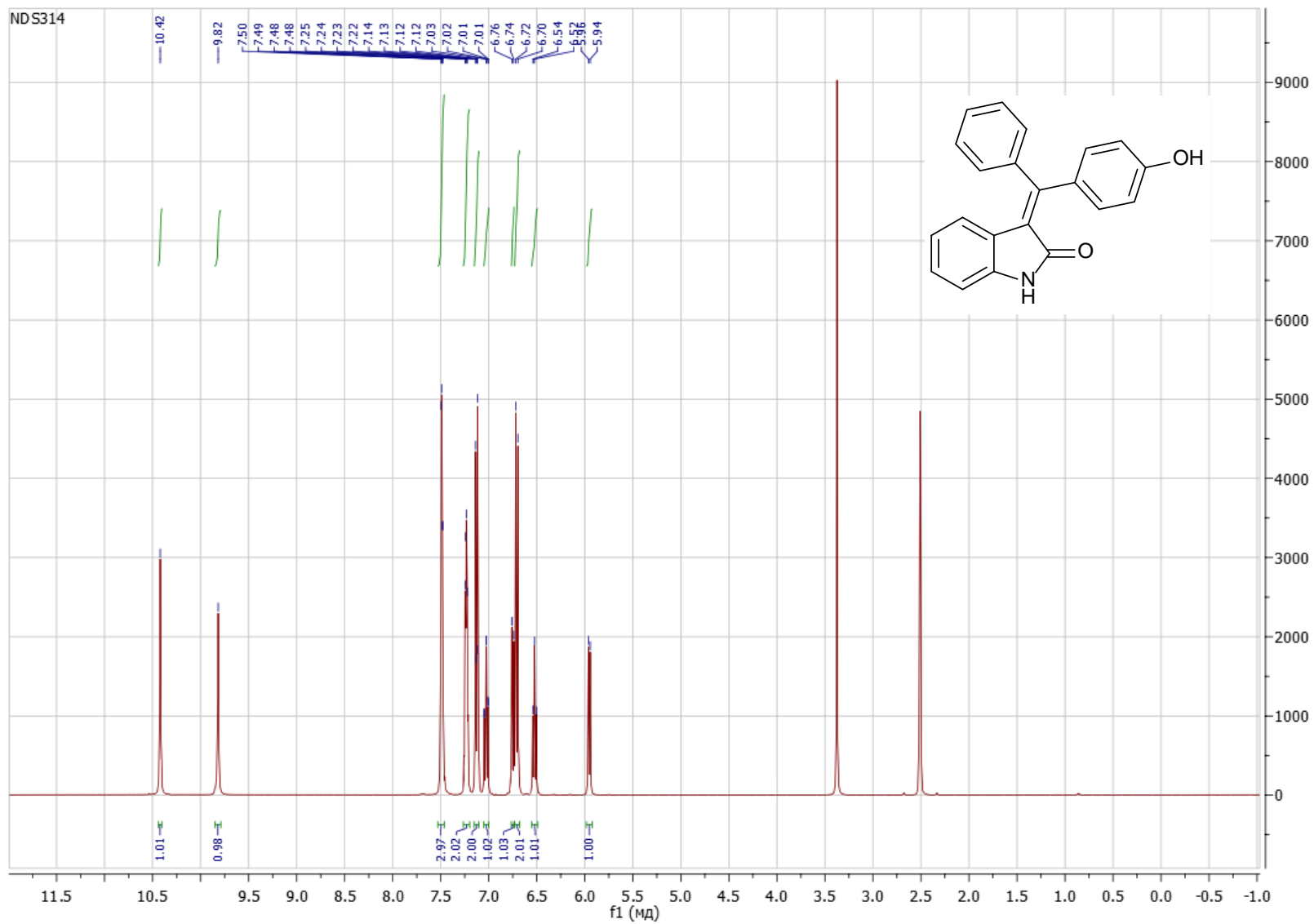
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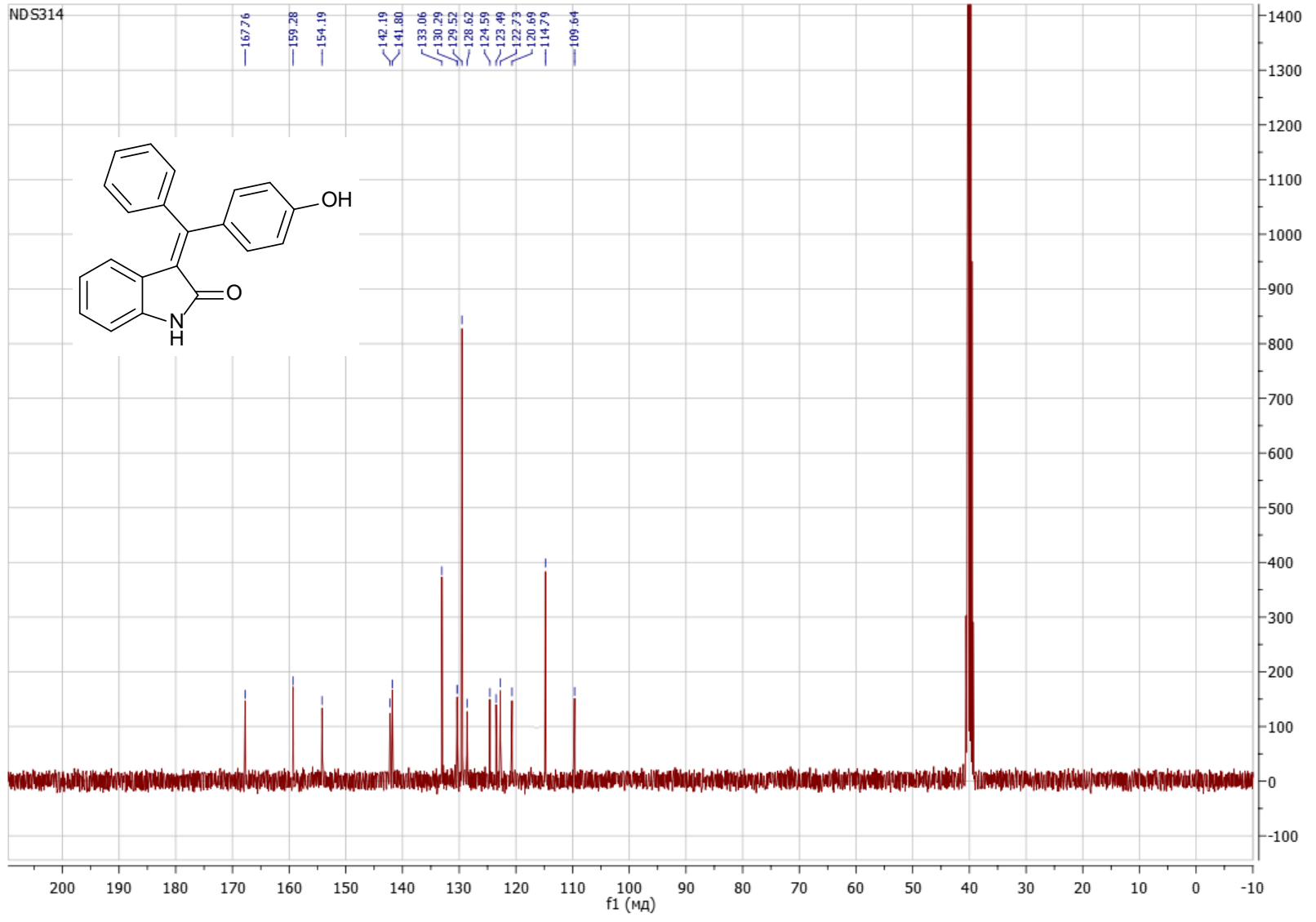
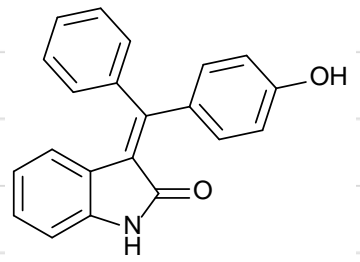
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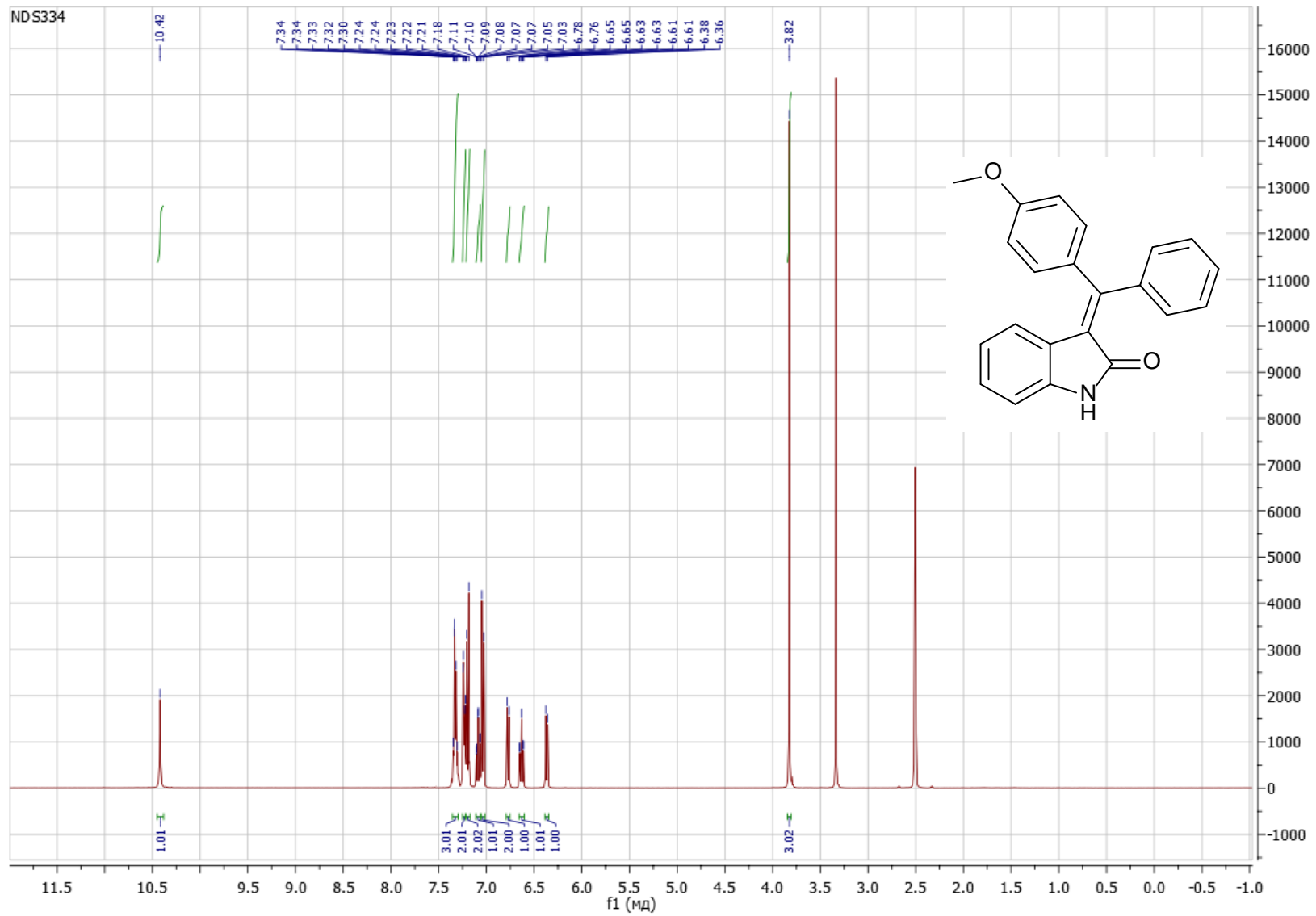
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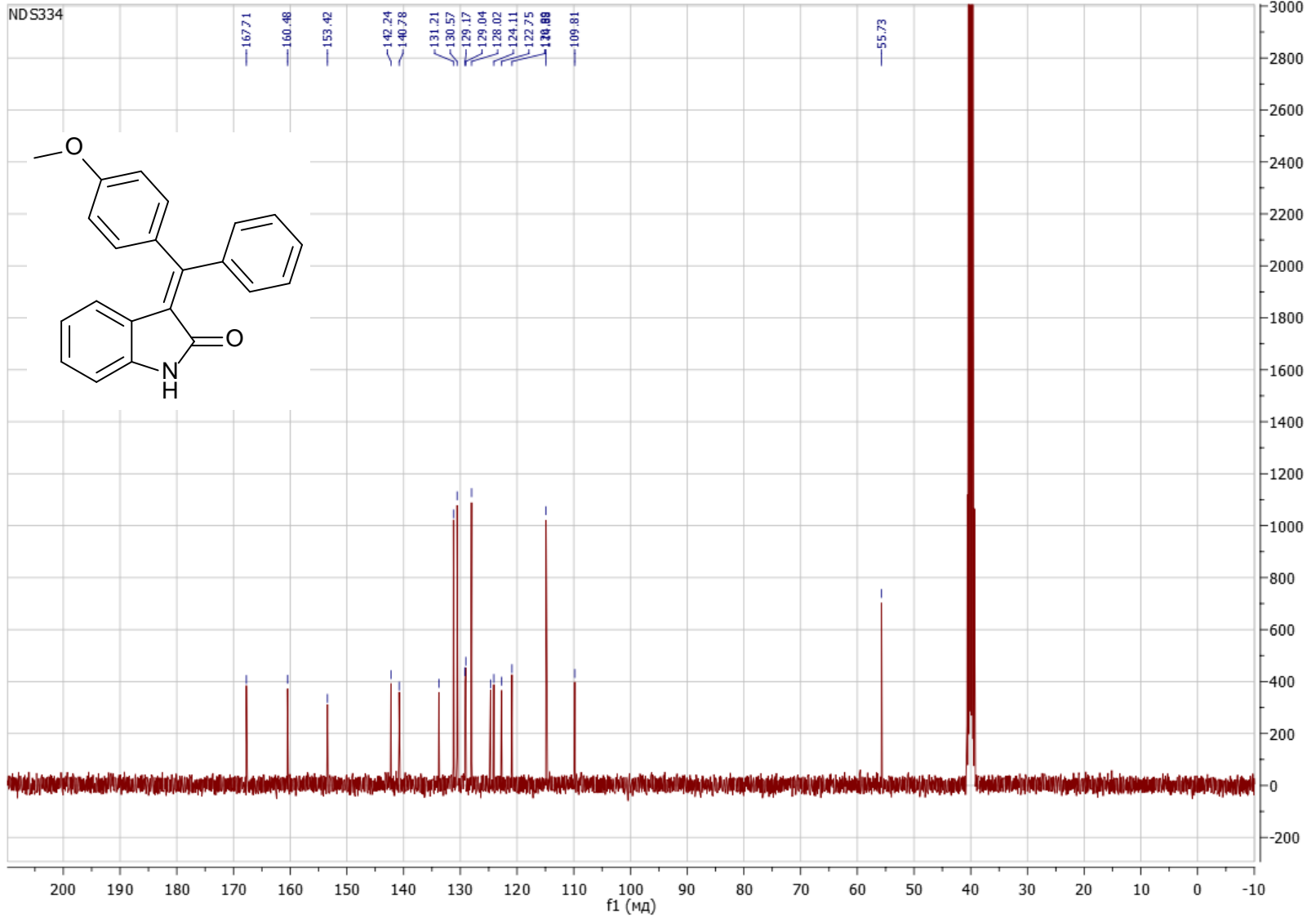
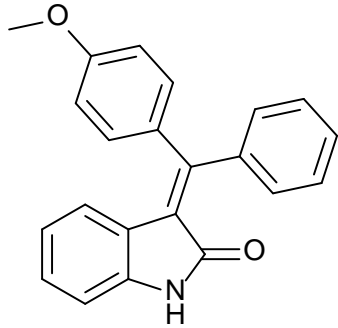
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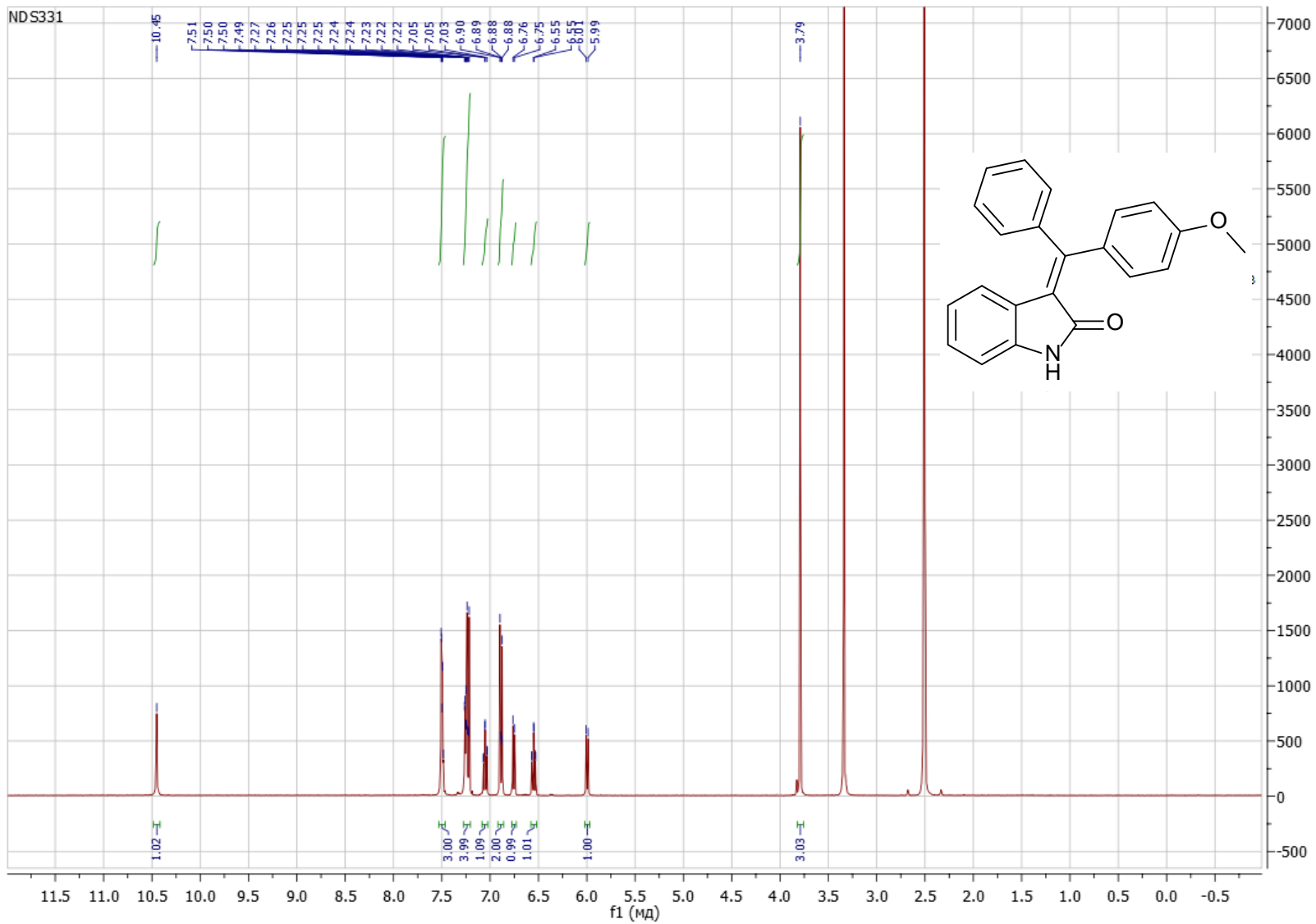
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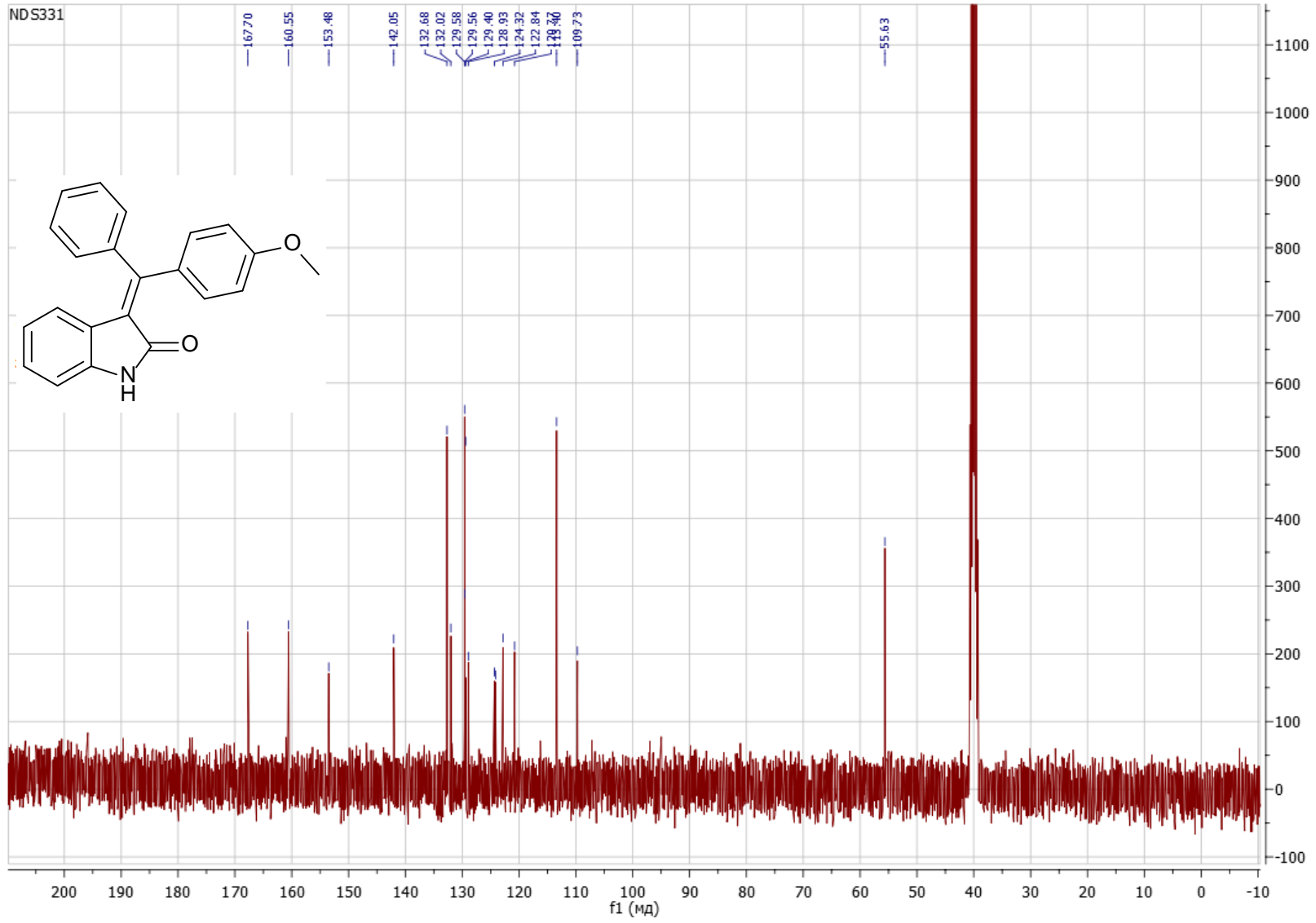
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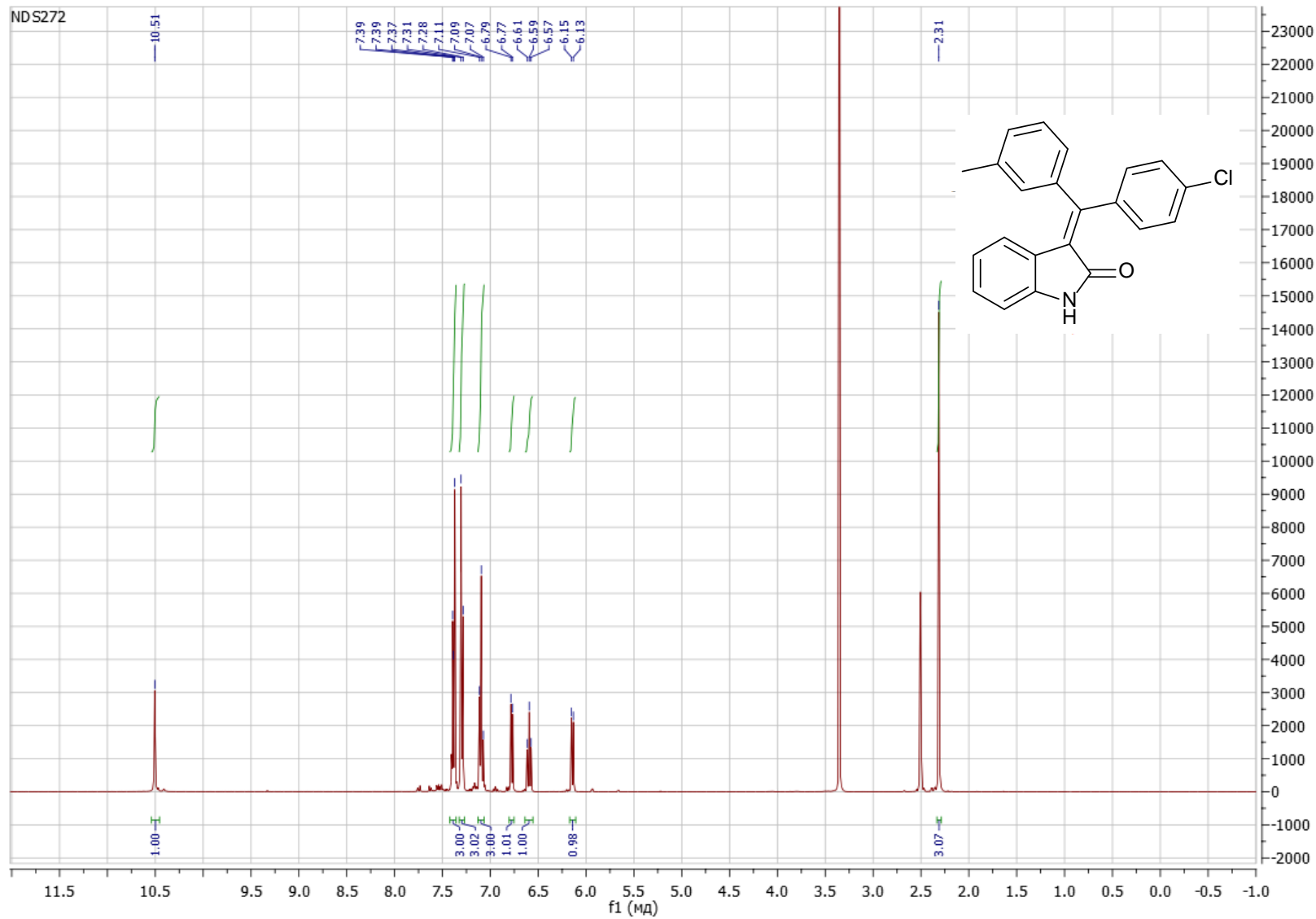


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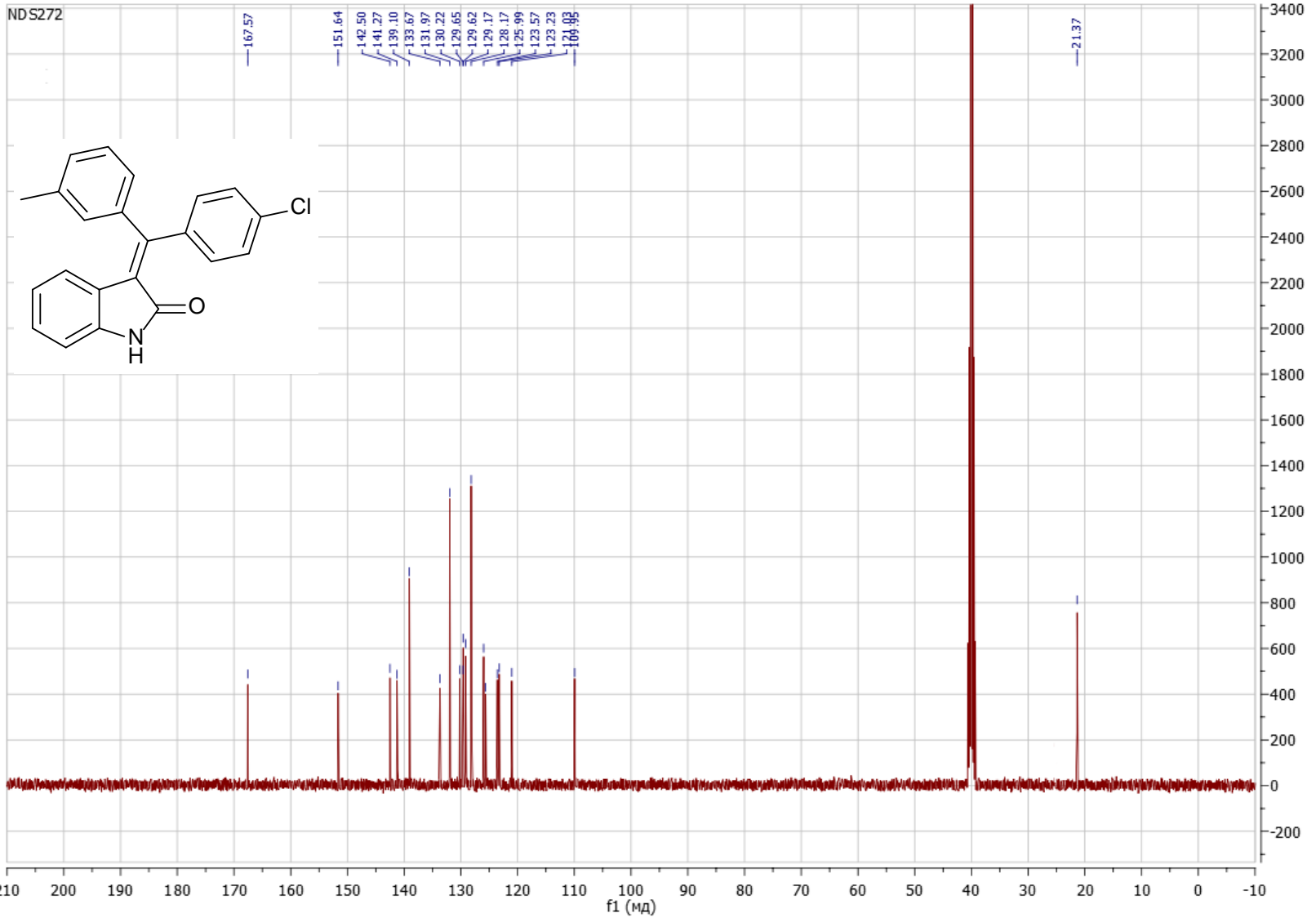




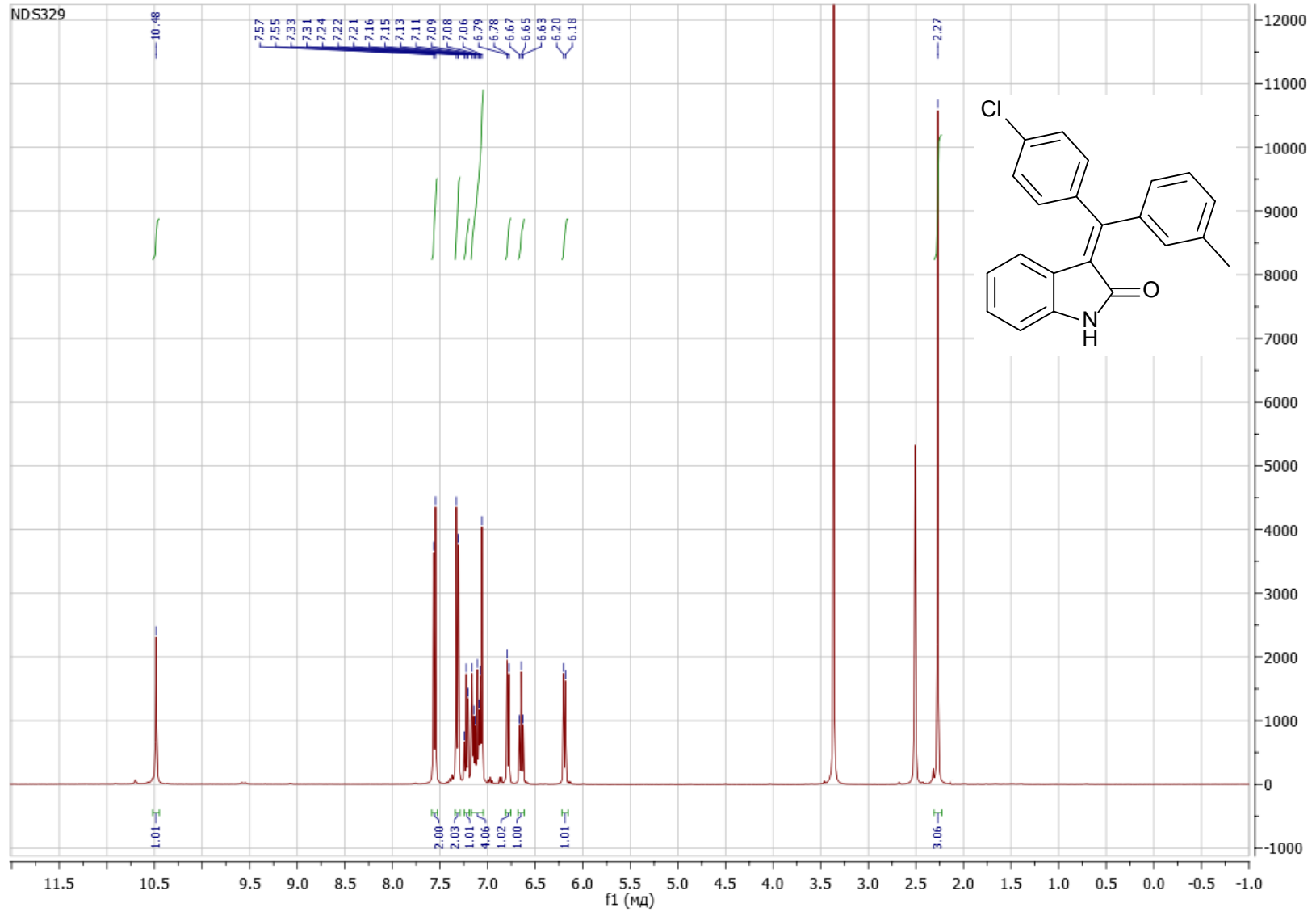
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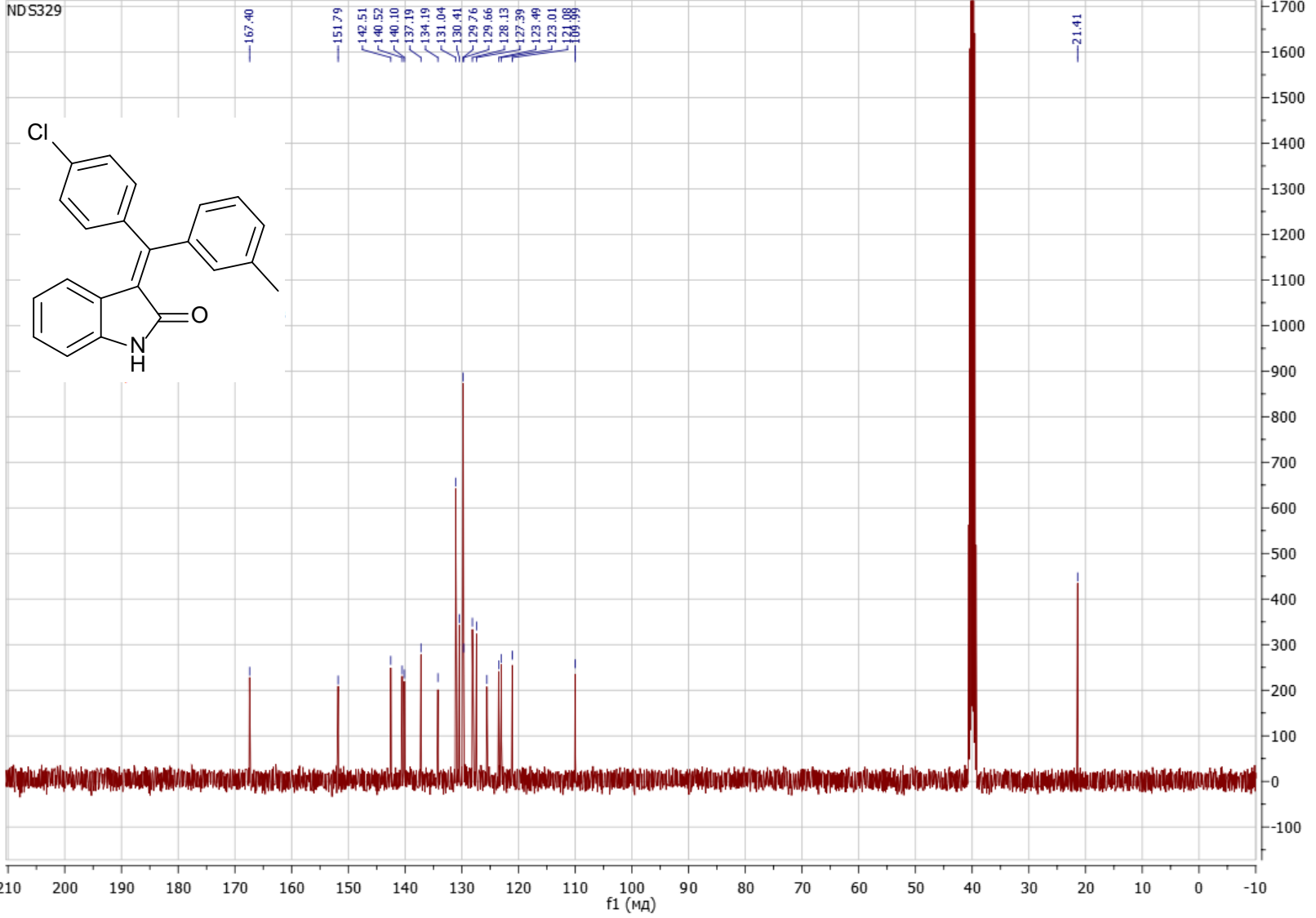
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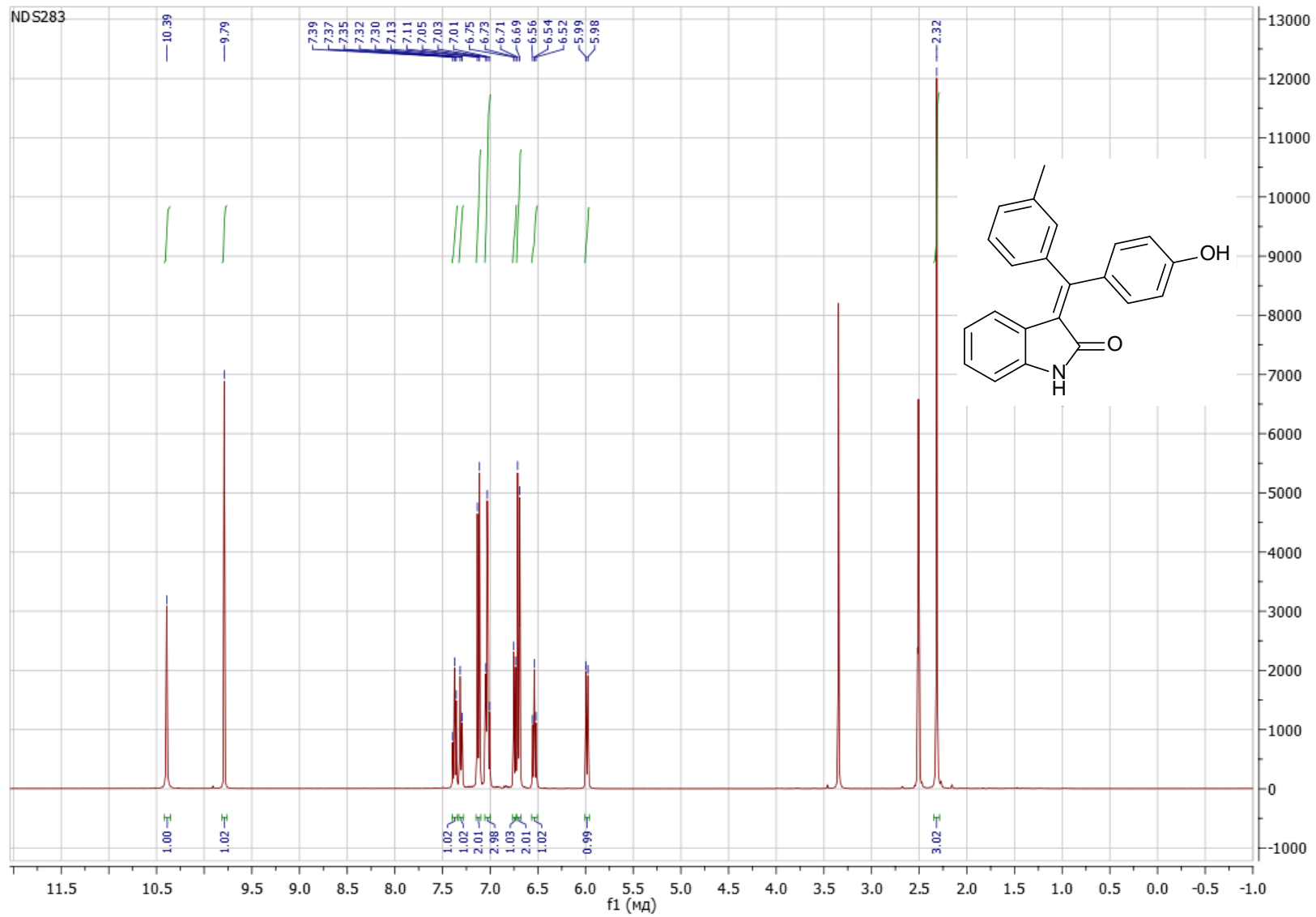
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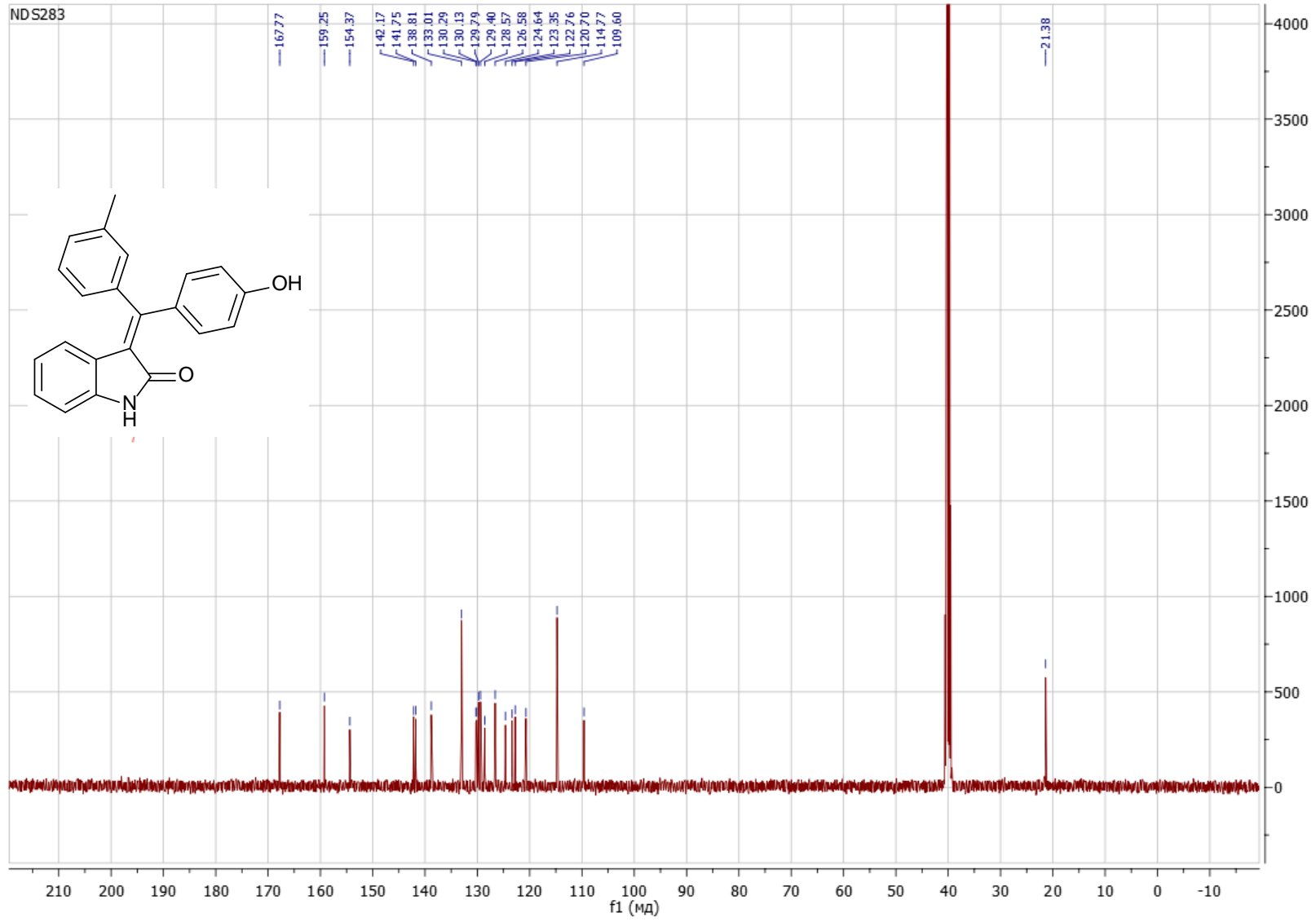
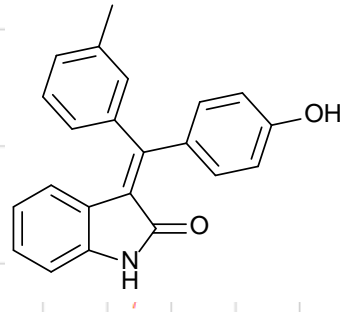
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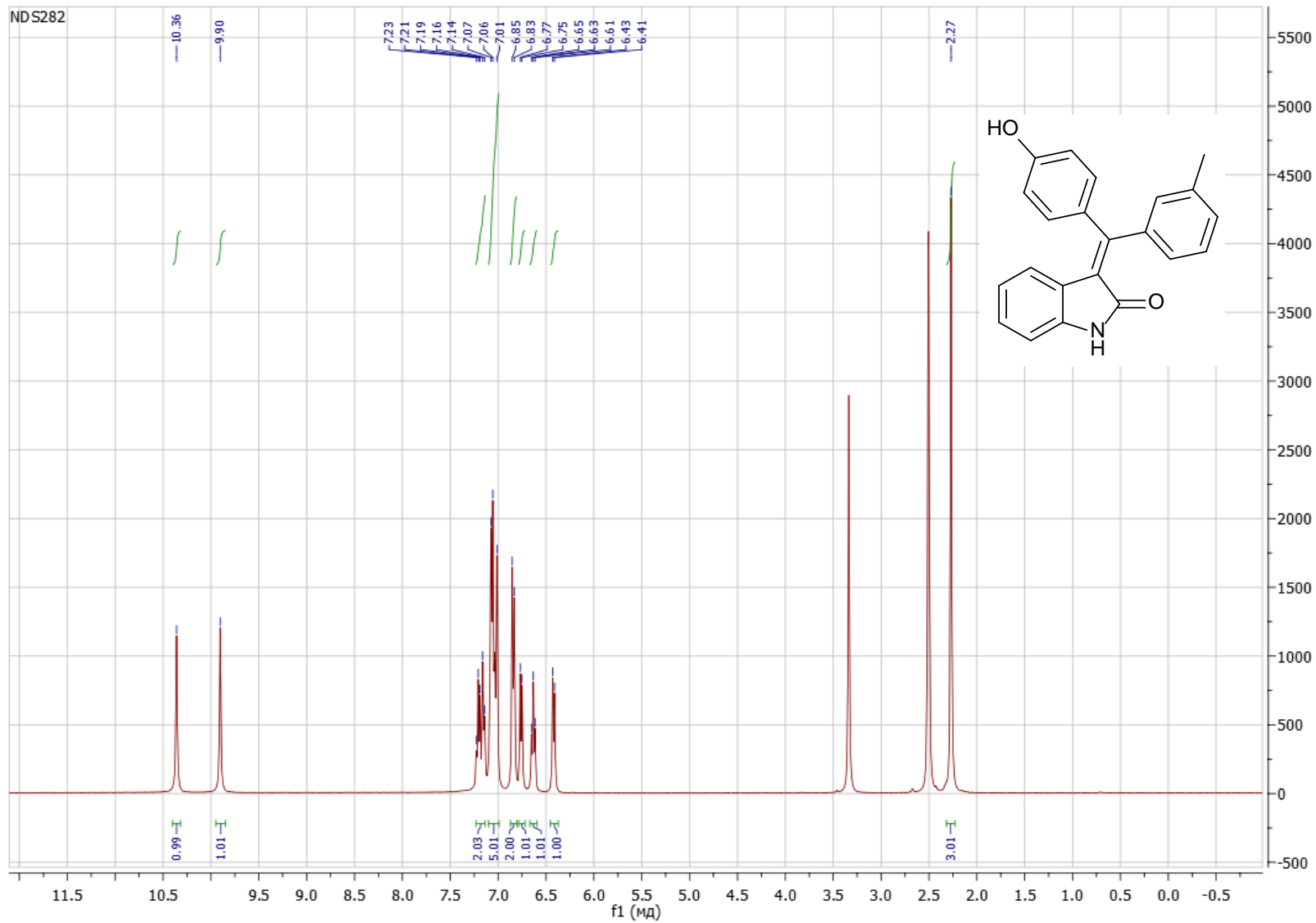
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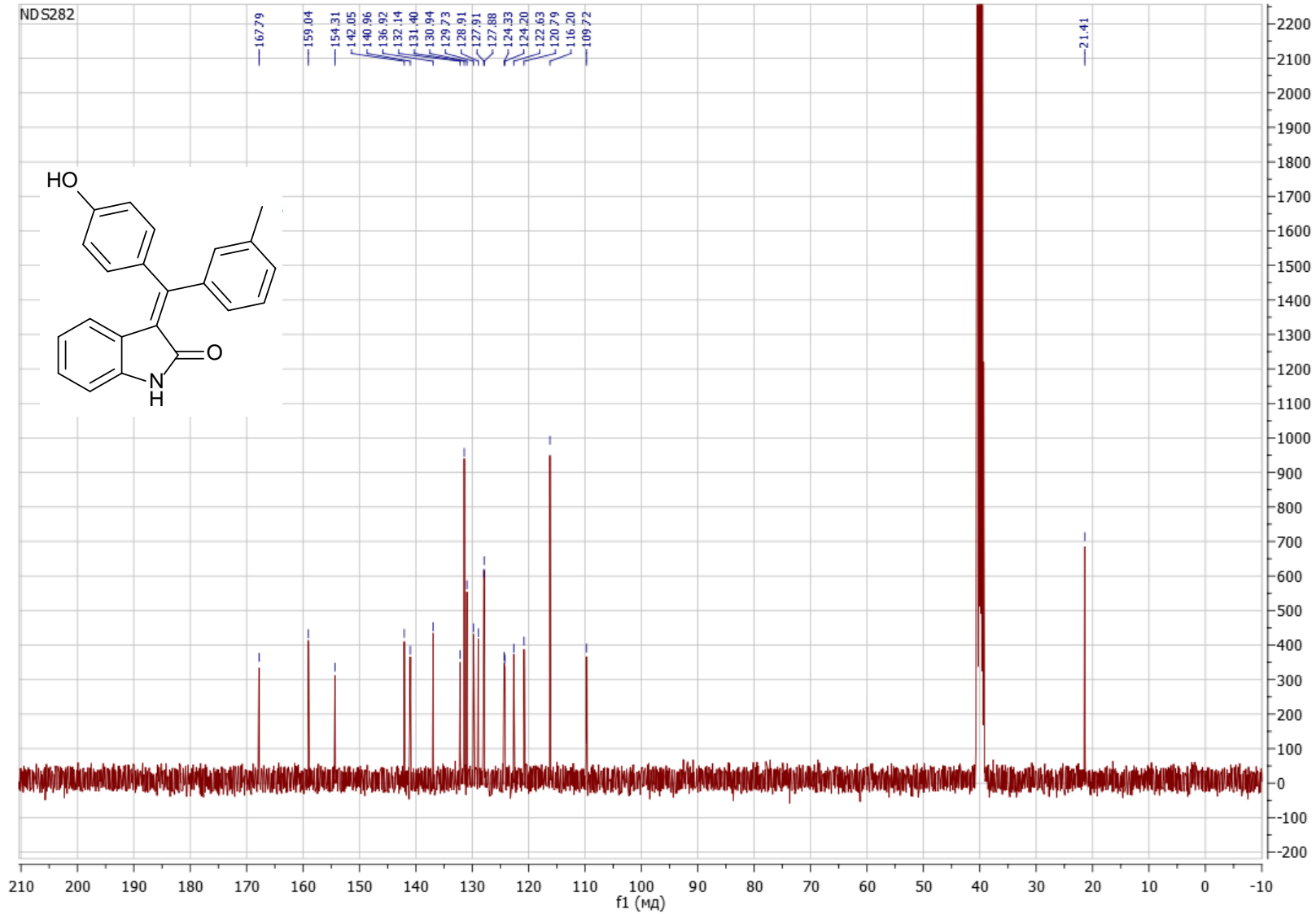
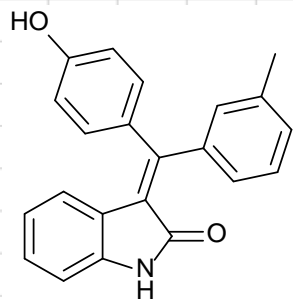
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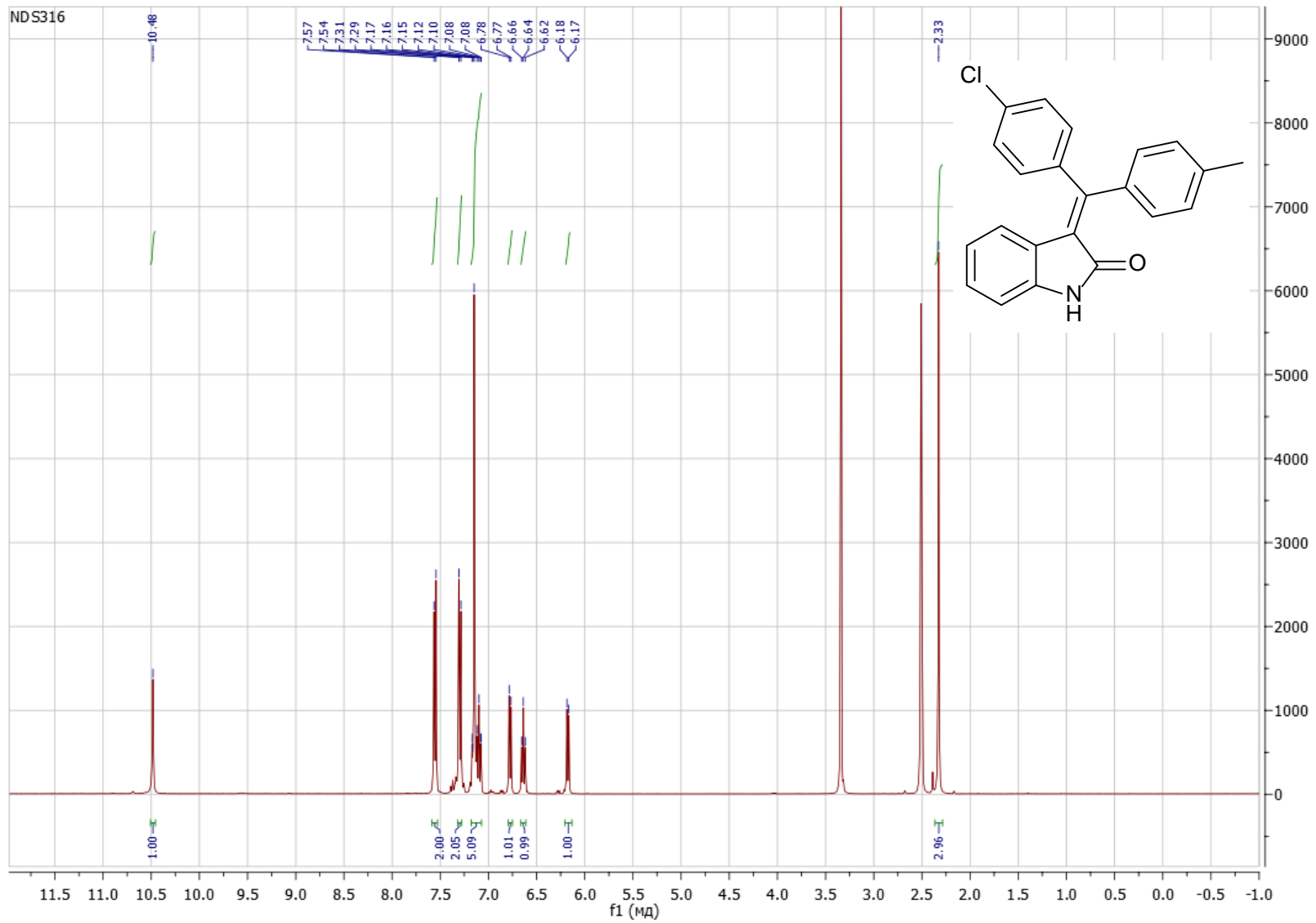


ND S282

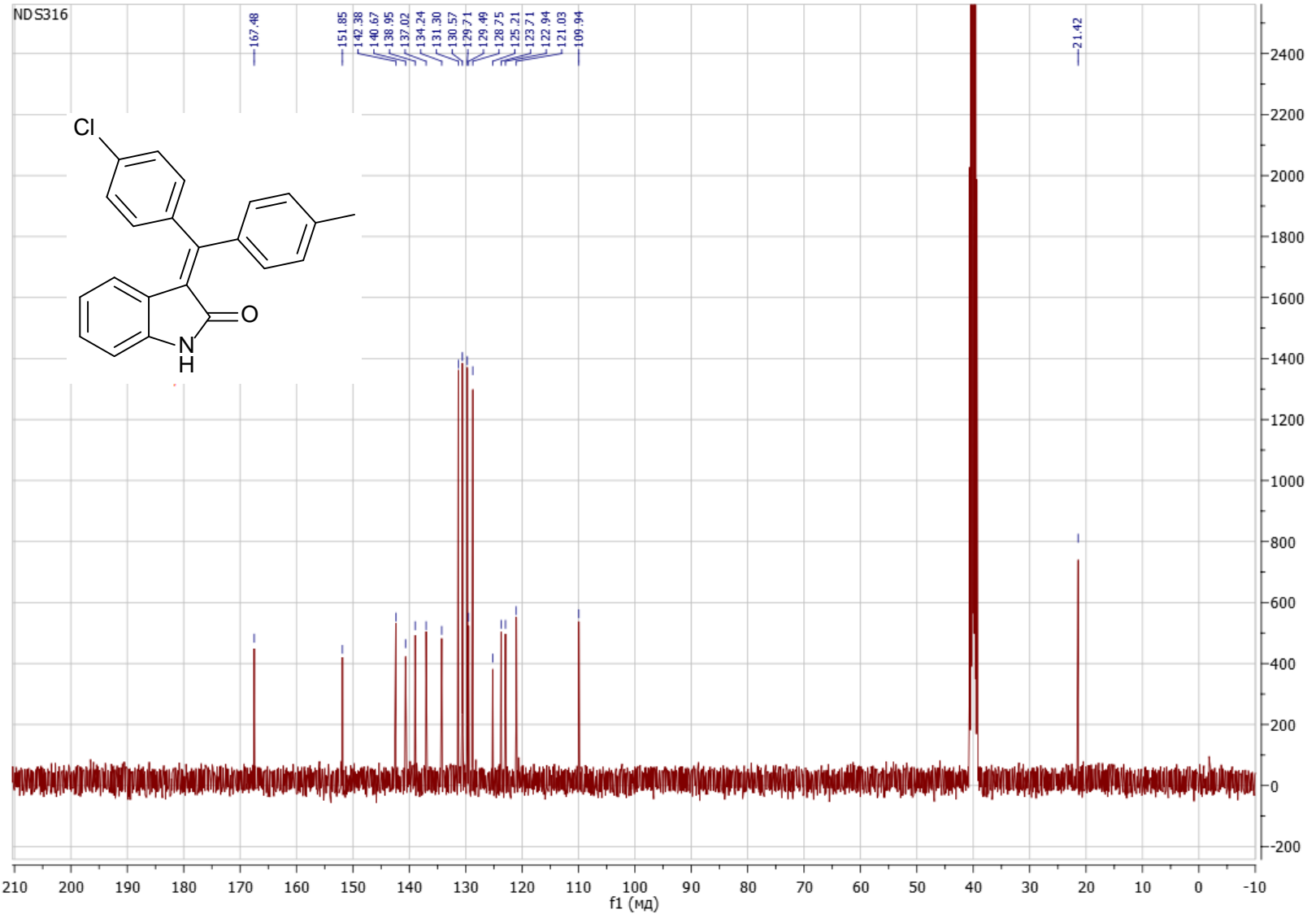
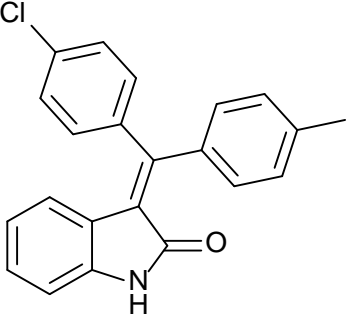




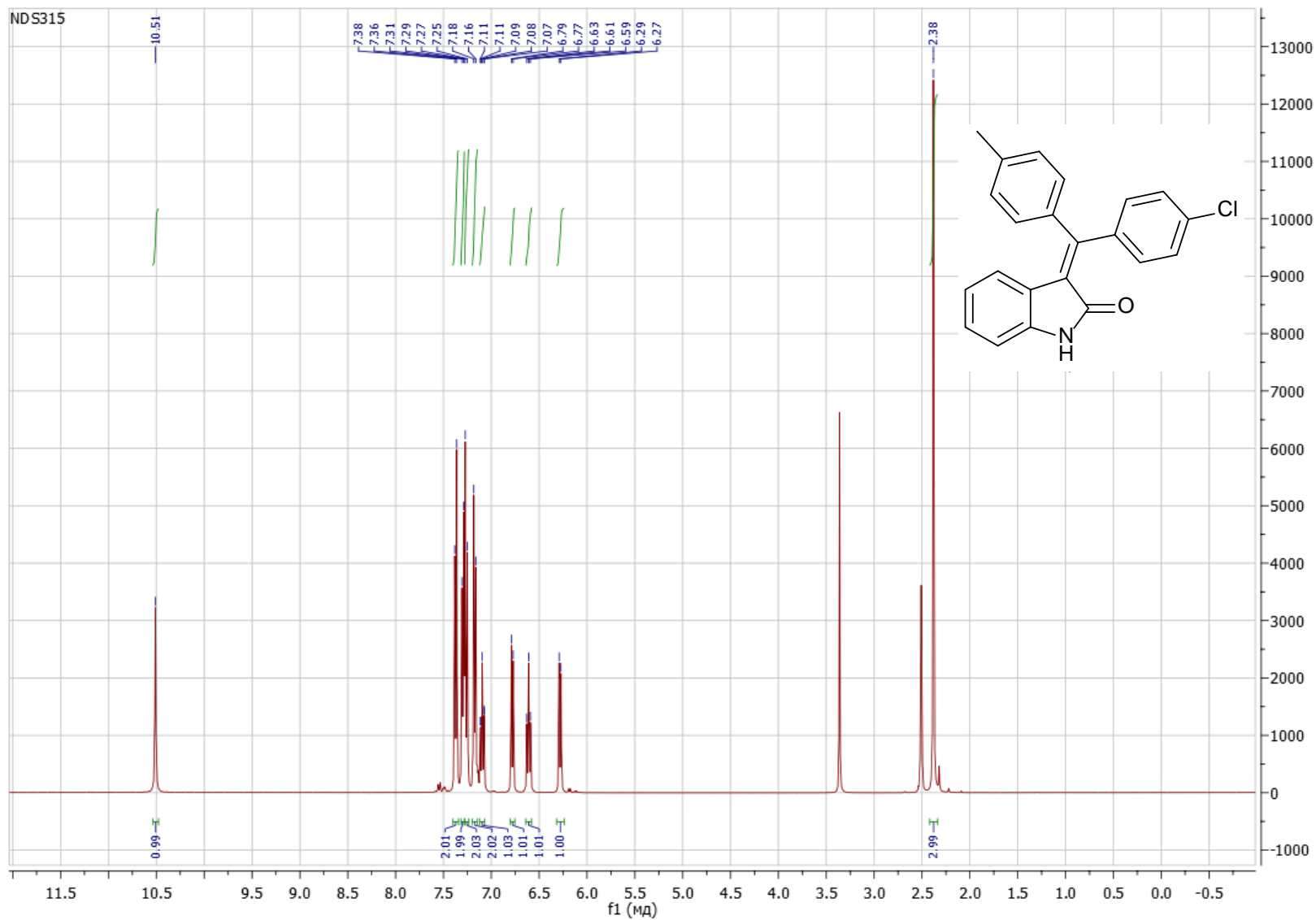
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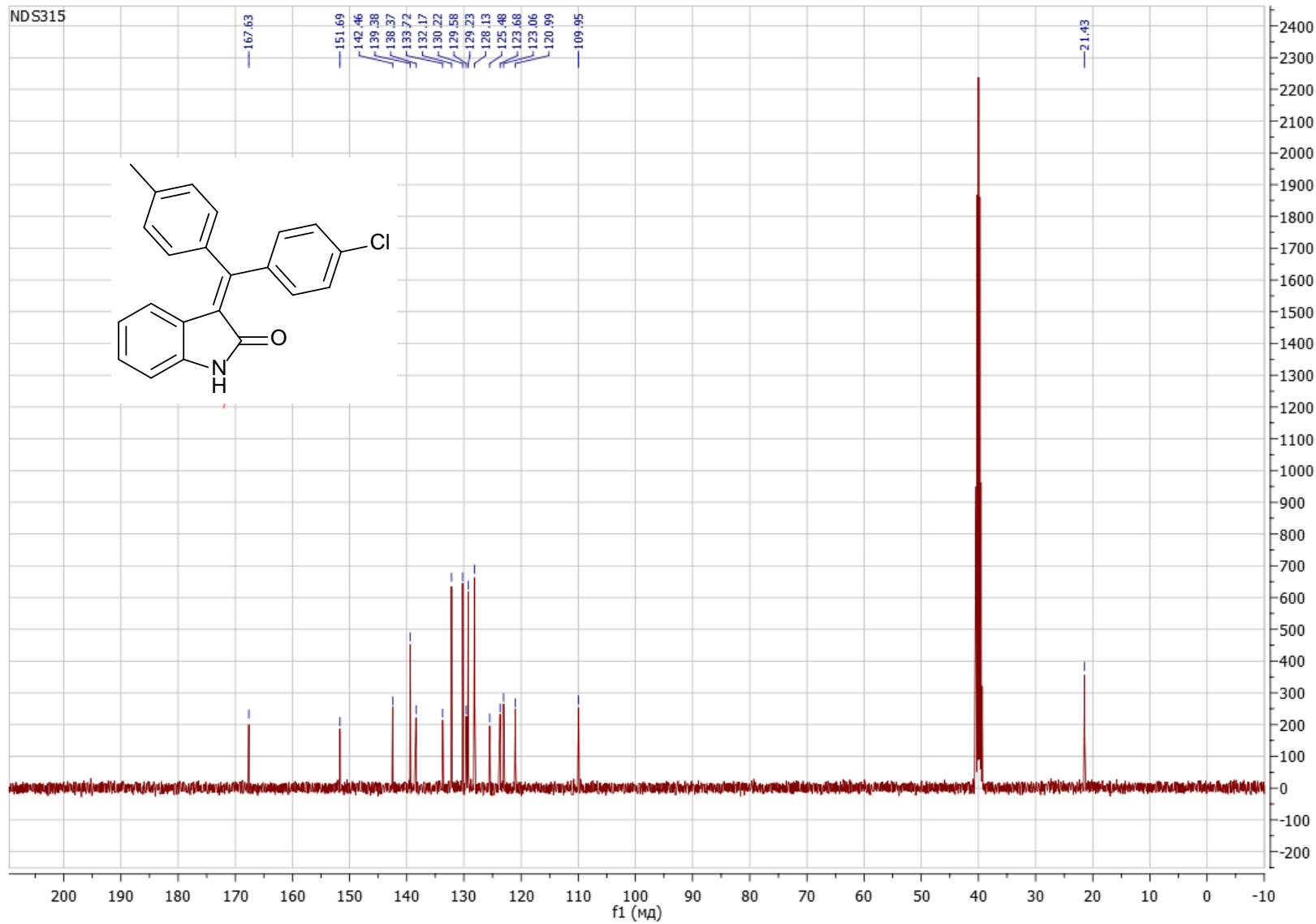


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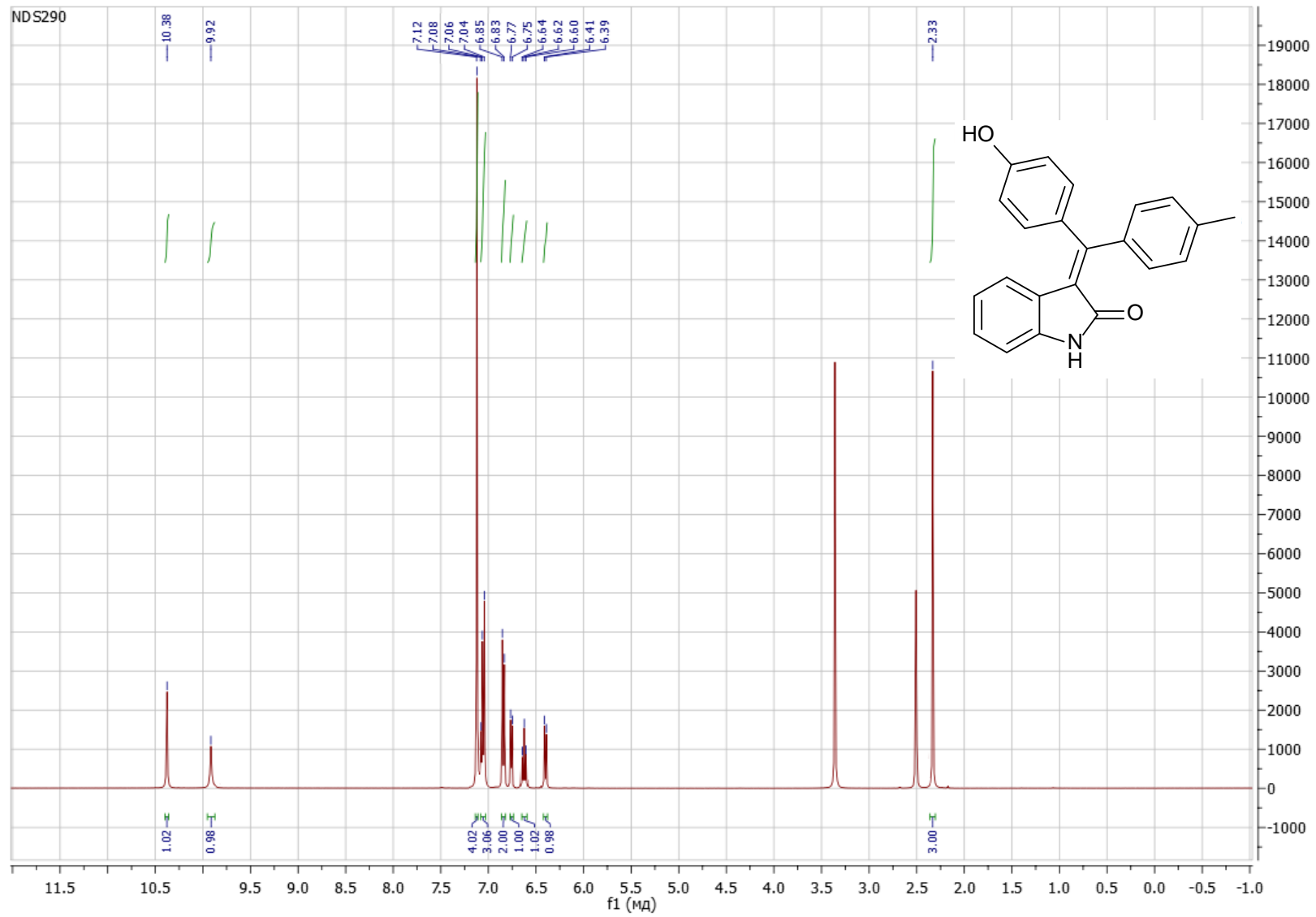


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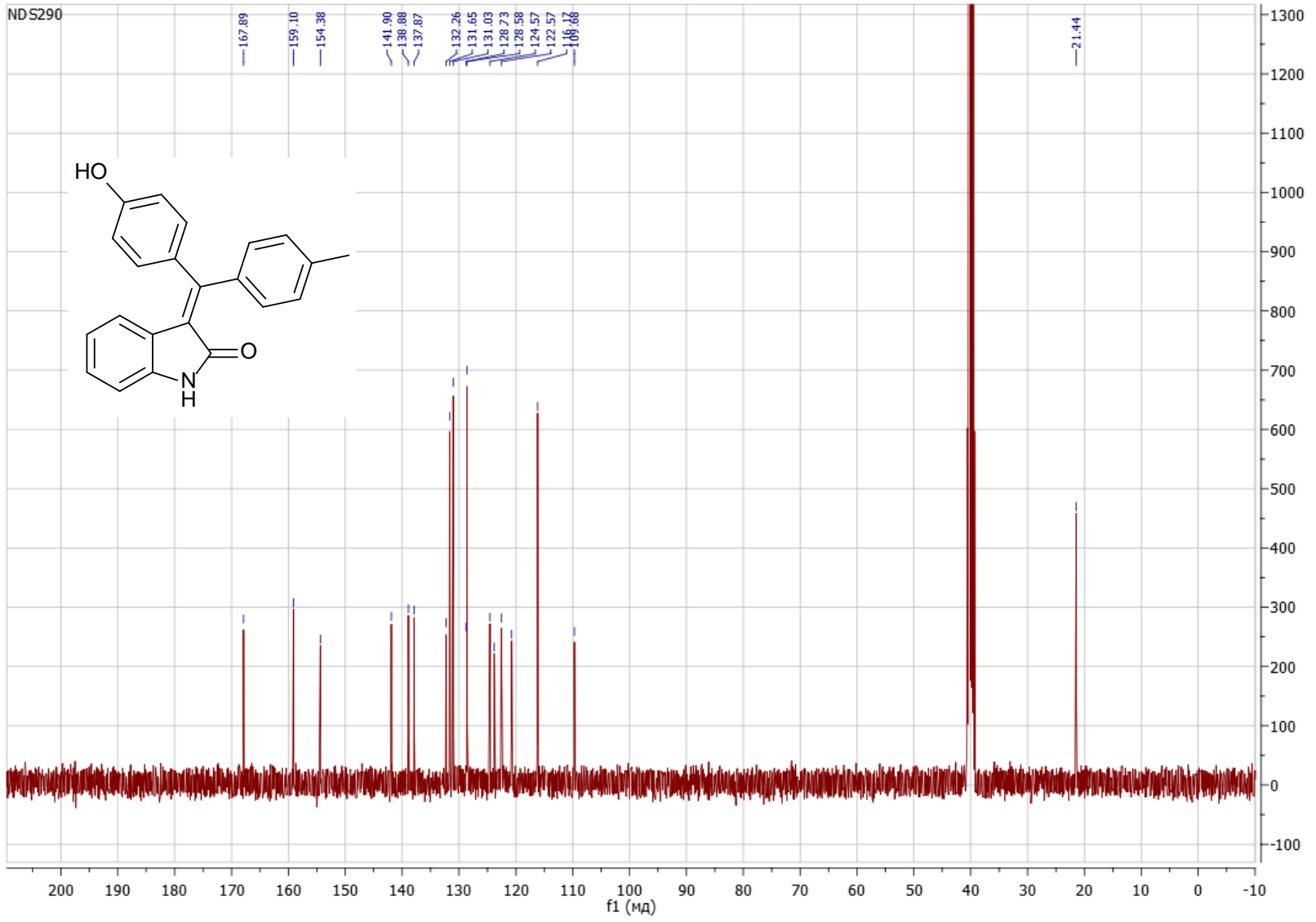
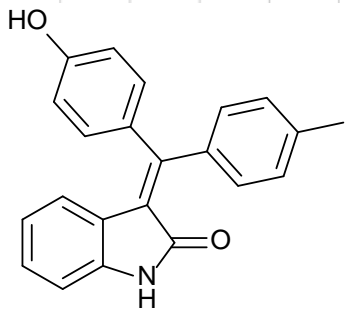




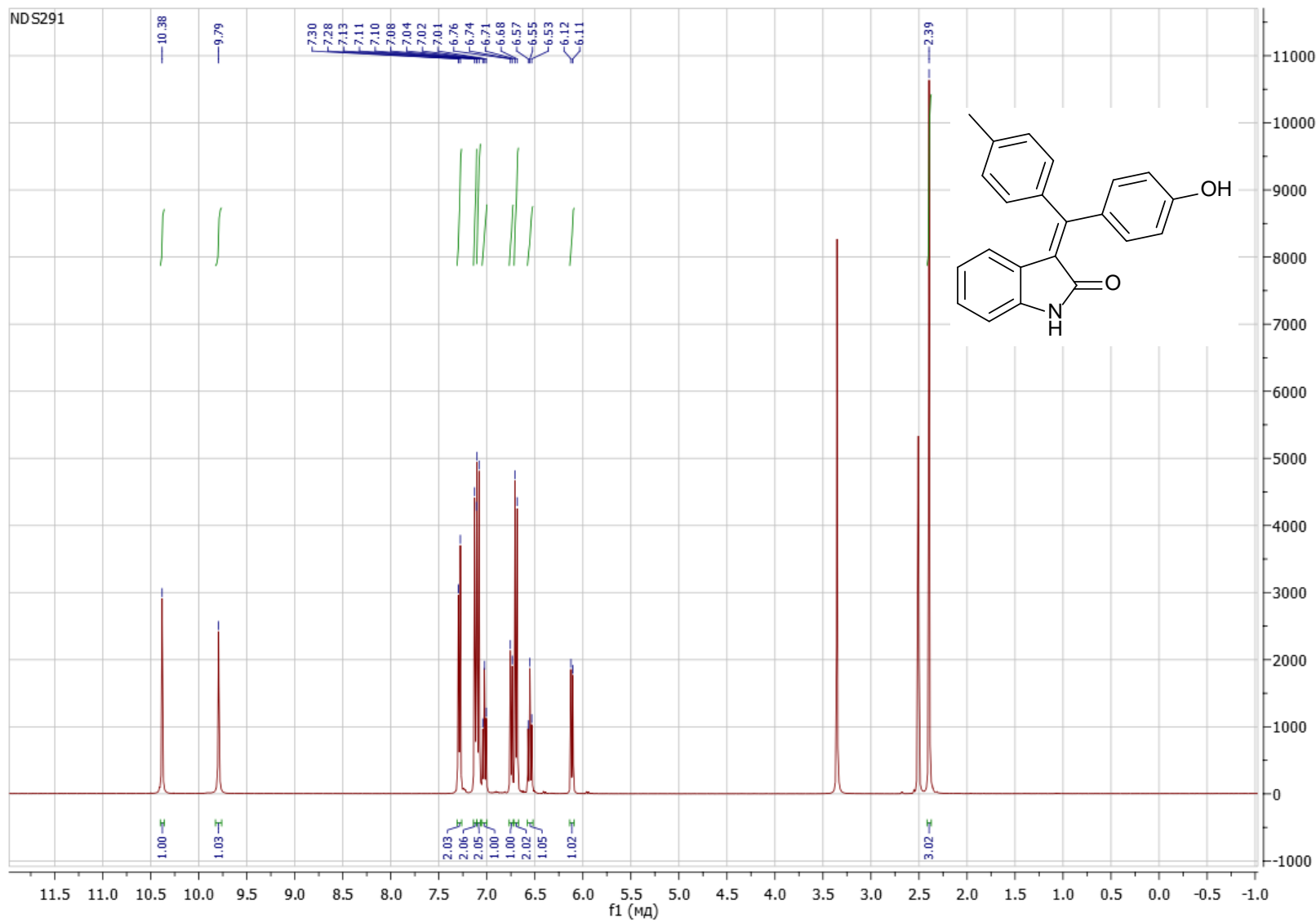
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NDS290



*(Z)-3-((4-hydroxyphenyl)(p-tolyl)methylene)indolin-2-one*



NDS291

